THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
The Institution of Electrical Engineers	589
Researches on Thermo-Electrics	590
What Engineering Owes to Chemistry	590
Electric Lighting of Graz	592
Electrostatic Alternators (*illustrated*)	593
Electric Lighting at the Castle of Fröschweiler, Alsace	594
The Electrical Habits of Iron	594
Electric Traction Discussed at the Cleveland Convention	595
The Induction Motor: Who Invented It? (*illustrated*)	595
The New Westinghouse Lamp (*illustrated*)	597
Parsons Steam Turbine Tests (*illustrated*)	598
Mr. Thwaites on Design of Steam Generators for High Pressures	599
Electric Traction on the South Staffordshire Tramways (*illus.*)	600
The Institution of Electrical Engineers	607
The New York-Chicago Telephone Line	607
Notes	608
Electric Lighting at the Guildhall	610
Contracts Open and Closed	611
Business Notices, &c.	611
City Notes, &c.:—West India and Panama Telegraph Company	613
Traffic Receipts	613
Share List of Electrical Companies	614
Legal:—John Hopkinson *v.* The St. James's and Pall Mall Electric Light Company (*continued*)	615
New Patents	618
Abstracts of Published Specifications	618
Correspondence:—Water-Motors	619
The Meter for the Million	620
Train Lighting	620
Dry Cells	620

J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1893,

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THE INSTITUTION OF ELECTRICAL ENGINEERS.

IT seems to us that the letter criticising the composition of the Council, which we, in common with the other electrical journals, published last week, is both ill-timed and illogical. Moreover, with all due respect to the five gentlemen who signed the petition, we fail to see that the necessary degree of significance is attached to the document issued under their auspices to affect the general conduct of the Institution, or why was it not signed by that "large and influential section of the Institute" which shares their views?

We are not at all sure that in this Society there are two extreme sections such as a contemporary suggests, nor do we believe that any special body of members can justly show that their numerical representation on the Council is insufficient. Let us examine the members composing it.

We will first take telegraphy, as this branch of electrical science was the only one in existence at the time of the inception of the Institution. We find this very fully represented by such names as Lord Kelvin, Latimer Clark, W. H. Preece, C. E. Spagnoletti, Sir H. Mance, M. Cooper, Major-General Webber, and one or two others; telephony by Prof. Hughes, W. H. Preece, Col. Jackson, Prof. Silvanus Thompson, and M. Cooper; electric lighting in its professional aspect by W. H. Preece, Major-General Webber, Drs. J. and E. Hopkinson, Prof. Crookes, Sir J. Douglass, Profs. Fleming, Forbes, Kennedy, and Silvanus Thompson, and constructively by Alexander Siemens, R. E. Crompton, J. Swinburne, and W. M. Mordey, besides Dr. E. Hopkinson and Prof. Kennedy, who would not, we feel sure, object to be included amongst those "actively employed in constructive work." The naval and military officers need not be specifically mentioned; but surely the compilers of the circular letter knew that nearly all the officers who have served on the Council have been honourably and intimately connected either with telegraphy or electric lighting, both of which are essential to military and naval operations?

Of the transmission of power or electric traction it is scarcely necessary to speak, for we have not yet advanced so far in these directions as to need special members of the Council to look after their interests; and the same may be said of electro-deposition, notwithstanding that in one quarter a large capital is, or rather has, been engaged in it.

We fail, then, to understand why a contemporary agrees with the malcontents that the Council does not represent the profession of electrical engineering, for to us it appears so fully representative, that if the Council were at this moment dissolved, we should see at the next election, and very justly so, nearly all the names now on the list. A council mainly of scientific men of world-wide renown, with a liberal sprinkling of the constructive element,

should be far better able to command the respect and sympathy of the body of members than would a council made up in a manner just the reverse, for surely nobody (except perhaps the writers of the letter in question) would desire that the Institute should be transformed into a commercial body, and vie with the Electrical Trades Section of the London Chamber of Commerce, where the "Constructives" can have it pretty much their own way.

What we require is, that the Council which has the responsibility of nominating its own members should give a longer list of suggested names on the ballot list, instead of confining the number to the vacancies caused by retiring members. If for the purpose of filling up, say, four vacant places, we had twelve names to select from, we think that the large and influential (?) section of the Institute which, we are told, is dissatisfied with the present constitution of the Council, might have its discontent allayed and console itself with the assurance that they could then make that body truly representative with no class or interest predominating over others.

But, whatever the constitution of the Council, we want better management with regard to the publication of the proceedings, a remark we have had occasion to make use of more than once previously, although that is not the question at issue now. We do not hesitate to express opinions adverse to the Institution, when we think that such a course is needful; in the case with which we have been dealing, however, we candidly confess that our sympathies do not lie with the signatories to the letter upon which we have commented.

The comparison of our Institution with that of the Civil Engineers is quite beside the mark, and robs the arguments of Mr. Erskine and his collaborators of much of the weight which might otherwise have been attached to them. A contemporary says:—"The Institution, like that of the Civil Engineers, is, therefore, largely what its members choose to make it." Let members, then, guard the interests of our Institution a little more jealously, and not be so ready, on the slightest pretext, to read papers (which, in strict justice, should be given to their own Society) before others because they think it invests their compilations with somewhat greater importance, and is gratifying to their pride.

RESEARCHES ON THERMO-ELECTRICS.

THE recent researches of Le Chatelier on the measurement of high temperatures by means of his special thermo-couple, acquires a new interest when considered in connection with a paper by Carl Barus on the thermo-electrics of platinum-irridium and of platinum-rhodium, which is communicated by the author to last month's *Philosophical Magazine*. In this paper he makes a comparison of the thermo-electromotive forces of iridioplatinum-platinum and rhodioplatinum-platinum within a range of temperature of about 1,700° C., with the result that he finds a relation to exist between the corresponding data of these two couples which is almost *linear*.

The method he employed was substantially as follows:—The hot junctions of the two couples were fused into a single globule before the oxyhydrogen blow-pipe. The wires were left bare for about 5 cm. above this, and the remaining lengths of the wire surrounded by a pair of fire-clay insulators. Thus they could be secured by a clamp outside the furnace. The cold junctions were submerged, side by side, in a bath of petroleum, at known temperatures. Here they communicated with the terminals leading to the apparatus for the measurement of electromotive force by the zero method. In order to insure identity of exposure and slow changes of temperature, the common globular junction of the two thermo-couples was imbedded in a mass of calcined lime contained in a large platinum crucible.

The furnace, with all parts in place, was first heated to 1,600° C. Then the burner was removed, and the furnace closed up and allowed to cool without further interference. Observations of the electromotive forces of the two couples were made *alternately*, every two minutes, during the time of cooling. The E.M.Fs. of the platinum-rhodium couples were then plotted graphically as a function of time (showing a remarkably uniform curve), from which the E.M.Fs. (platinum-rhodium), for the times at which the observations were made could be taken with an accuracy of 0·1 per cent.

The data are arranged in tables. Table I. contains a comparison of the thermo-electrics of the platinum-iridium and the platinum-rhodium couples; Table II. of iridio-platinum and rhodio-platinum. The results are worked into a very instructive chart.

Barus discusses the incidental change of curvature shown on the chart, and the influence of the agencies which determine the slight departure from the linear relation of the thermo-electric powers. And he appears to be of opinion that the ratio of the powers of these two couples is probably constant throughout the whole interval of over 1,700° C.

He thinks he can make a strong point by claiming that the change of electromotive force with temperature, in both these couples, is thoroughly normal; for if there were anomalies present, they would have to be similarly and symmetrically situated in two different couples—a much more improbable assumption. In short, the thermo-electric behaviour of iridioplatinum-platinum and rhodioplatinum-platinum couples may safely be looked upon as embodying a thermo-electric law, the nature of which is thus made accessible throughout an enormous range of temperatures. This law, Barus thinks, is not fully contained in Prof. Tait's equation; nor, it may be added, did Prof. Tait claim that it would be.

WHAT ENGINEERING OWES TO CHEMISTRY.

THE interweaving of the Arts and Sciences and their relative indebtedness to one another, is the theme just now of many magazine writers; it is always worth while to devote a little time to "taking sights," and to mark our *locus* on the chart of the ages; it makes the past more definite and the future less difficult.

We are referring, now, especially to an article by Mr. A. L. Griswold, M.E., in the *Engineering Magazine*, in which he traces the course of "Engineering" with "Chemistry," and co-ordinates them in a very graphic and pleasing manner. He shows how chemistry has first given the engineer materials with which to work, and has then enabled

him to apply his skill to those materials in the most economical way.

In the field of alloys, he shows what a harvest has been reaped by engineers from the discoveries of the chemists. Metals resistant to the action of acids and to other corrosive agencies and metals combining great strength with lightness, have been invaluable aids to progress in the mechanical arts.

Electrical engineers owe to the resources supplied by chemistry, perhaps, a larger debt than they are at first sight willing to admit. The various types of steel and iron used for field magnets and armature discs, for sheathing wires of cables, for land-lines, are the outcome of experiment and trial. Strength, durability, permeability, resistance—these are the questions of the electrical engineer; carbon, manganese, annealing, refining, alloying—this is the answer of the chemist and metallurgist.

Before an engineer can theorise towards economy and efficiency in machine design, he must be provided with definite data about the materials he is to use, and he must be certain that he can get his materials of standard quality. It is here that the chemist helps him.

Anyone who has watched the making of steel by the Bessemer process finds the truth of these things at a glance. The practised chemist tells you at each moment what stage of development the steel has reached, even without the spectroscope. He knows by the way the sparks fall and burst whether his enemy Phosphorus has yet been eliminated from the seething mass; Sulphur he knows, too, and all the host of them by long and careful study: experiment and trial, and then a guiding rule. The chemist of the future will probably be able to predict the permeability of his iron by the curl of the smoke from the factory chimney, and direct integration.

Specifications.

THERE was a time not so very long ago when the tenderer was left pretty much to make his own specification. Now we hear it said that the specifications of local bodies contain every onerous clause to be found in those previously issued, plus another or two specially invented for the occasion. The tenderer has to speculate as to which clauses will be strictly enforced, and which will not. This may account for the fact that recently the tenders for a town plant, &c., all being from firms of repute and to the same specification, varied from £15,000 to £25,000. *York City.*—One of the conditions under which tenders for the lighting of York will be examined reads as follows: "Each tenderer must substantiate his tender for working cost by furnishing an extract from the form of accounts required by the Board of Trade from a Local Authority or Company possessing statutory powers who have worked the system proposed for a period of not less than one year." No doubt the Kensington and Knightsbridge Company could furnish these accounts; but could any but low tension systems do so under the following terms of the specification:—"No high pressure system without low pressure network, as transformers in houses are not permitted by the Board of Trade," seeing that no high pressure system with a low pressure network has, so far as we are aware, been in existence for 12 months. We believe that this specification was drawn by Mr. Crompton, but hear that, as his company intends competing for the work, he has honourably resigned the position of consulting engineer in the matter.

Electric Light Fatalities.

WE are sometimes awakened from our state of general security by accidents which show that death is constantly at the heels of mankind, ever ready to take advantage of the most trivial act of carelessness. There has been in England a rare immunity from fatalities due to electric shock, and certainly negligence has been the cause of most of them. The latest victim is Thomas P. Lang, late in the employ of the House-to-House Company as assistant fitter, who, while engaged in drawing back a live cable apparently came in contact with the bare copper, and received a current at a pressure of 2,000 volts. A coroner's jury returned a verdict of accidental death, adding, as a rider, that they attached no blame to the company. The reason for the rider is that the officials of the House-to-House Company, in evidence, laid stress on the fact that they had issued rules to the effect that men were not to work on cables without India-rubber gloves. Lang neglected this rule, and paid the penalty. From one point of view this is an easy way of shifting from their shoulders the responsibility of a man's death; but there is a reverse side to every medal, and we cannot accept the view of the jury that the company were without blame. In the first place it is a most iniquitous thing that men should be sent to work on cables carrying currents of high voltage. It is as wrong as it is unnecessary. There are four or five hours in the day when absolutely no current is passing along the cables, and work that has to be done should be done then. It is depending on a broken reed to expect that India-rubber gloves are absolutely safe. Surely with rough work they are liable to be worn through or torn, and we all know that the insulation of cables is very often cut away, leaving the copper bare. A live cable without insulation and a torn glove are of themselves sufficient to bridge the span of a man's life. We cannot fail to see in this instance utter disregard for human life, and we must be allowed to protest against it. If the evidence at the inquest is correctly reported in the newspapers, we must speak of the careless, culpable way in which statements were made. Mr. Bowden, assistant manager to the House-to-House Company, for some reason or other best known to himself, says "that he had carefully examined the cable, and had no hesitation in saying that it was a cable that any man could safely work on with the current on." Asked to account for the accident, said "that the man when pulling the cable out must have come to a part where the rubber was off the wire." Yet this witness does not hesitate to say that it was a cable that any man could safely work on. Judging from the evidence of Mr. Bowden, and we must again say, as reported, there appears to have been an attempt to show that the man's death was not caused by electric shock. It is a pity that it seems necessary to throw as much mystery as possible about a death by electric currents, for such attempts are neither wise nor fair. Perhaps the advocates of alternating currents of high tension will some dry admit that there is an element of danger in their use.

Heating of Armatures.

PROF. RYAN has recently drawn attention to the importance of getting good qualities of iron in armatures, with a view of reducing the no-load heating brought about by hysteresis. It appears from his results that the radiation constant (or watts radiated per square inch of armature surface) is in American drums about ·034, and that the usual rise of temperature is from 70° to 75° Centigrade. Since the limiting temperature is reached by the combined ohmic and hysteretic losses, it is manifestly very important to get the latter as low as possible in order that the armature may carry a good load without overheating.

ELECTRIC LIGHTING AT GRAZ.

[FROM OUR OWN CORRESPONDENT.]

UNDER this title you gave in the number of the ELECTRICAL REVIEW for October 21st, a report on the invitation for tenders for the introduction of the electric light and the distribution of power issued by the town of Graz, and I am now in a position to give you a report on the result of this invitation which is interesting from several points of view.

Altogether four firms have taken part in this competition: Siemens & Halske, the Graz Gas Company, Schuckert & Co., and the International Electric Company of Vienna. The tenders of these several firms are in some of the most important points so heterogeneous, that we might almost feel disposed to conclude that the parties tendering had ventured without any experience into a region not thoroughly known to them, or that their tenders were not to be taken in earnest.

It is peculiar that, with the exception of the International Electric Company, all the parties tendering accept the condition, according to which the concessionary would have to undertake the risk for the results of the proceedings which the local Gas Company threatens, in case a new undertaking obtains the concession. The International Electric Company alone stipulate that the concession shall come into force only after the action with the Gas Company has been favourably decided.

Very characteristic is that passage in the tender of the Gas Company, in which it agrees to reduce the price of *gas* to an important extent in case it obtains the concession for the electric lighting. This is therefore an open admission that it will seek to extend gas lighting at the cost of electricity, and will aim at thrusting the latter into the background as an expensive luxury.

In the following I give you a conspectus of the tenders which are equally interesting and characteristic:

Conspectus of the Conditions of the Tenders for Electric Lighting and Transmission of Power, on which the above named firms

I. *Guarantee for the Process against the Gas Company.*

Siemens.	Gas Company.	Schuckert.	International.
Not required.	Not required.	Not required.	Condition not accepted.

II. *What Sections of the City are to be Lighted.*

Inner city, section I.	Section I.	Entire inner city and section II. where consumption appears certain.	Agrees to 10 kilowatt hours per year and metre run, or 200 burning hours per year and metre.

Leads to be put down forthwith by

Siemens.	Gas Company.	Schuckert.	International.
List of streets, names chiefly abridged.	Like Siemens.	Inner city.	List of streets.

Works to pass into the possession of the City.

On October 1st, 1912, at 10 per cent. *above* valuation price. Further, on October 1st, 1937, the net of cable may pass gratis into the possession of the city and the works at valuation.	On October 31st, at 10 per cent. *over* valuation price.	On October 31st, 1912, at valuation + 25 per cent. Offer after 35 years, October 1st, 1928, to hand over cable net gratis and works at 50 per cent. *below* valuation.	Like Schuckert, only works to be handed over at valuation price.

The Community to obtain the installation gratis.

October 1st, 1945.	In 50 years.	In 45 years.	In 50 years.

What System to be used.

Continuous or rotatory current.	Continuous.	Continuous with accumulators, or alternating current.	Alternating current with transformers.

Tension in the Leads.

Siemens.	Gas Company.	Schuckert.	International.
Continuous current 550 volts, rotating current 2,000 volts; in lamps 120 volts.	Maximum in leads 2,000 volts; 200 in lamps.	In lamps from 100 to 200 volts.	In primary leads 2,000 volts; in lamps 50 to 100 volts.

Leads Offered.

Patent lead cable, double iron bands. In the town park, along the railway or the river, bright copper.	Cables.	Cables with Felton and Guilleaume's double lead sheath and iron armature.	Partly aërial and partly underground.

Ground Rent offered by the Tenderers.

All offer 1 kreutzer per metre run of main lead.

What share of profit is offered to the city?

1 per cent. of gross profit on 3,000 lamps, if net profit from 7 to 8 per cent.; 15 per cent. if net profit exceeds 8 per cent.; 20 per cent. on the excess.	Progressive share in net profit above 5 per cent; from 5 to 6 10 per cent.; from 6 to 7 20 per cent.; and from 7 to 8 30 per cent.	6 per cent. of gross returns up to 10,000 lamps; 8 per cent. on more than 10,000 lamps; 10 per cent. on more than 20,000 lamps.	3 per cent. on gross profit.

Measurements and Hire of Meters.

If no special agreement.		Yearly.		Yearly.		Yearly.	
Yearly.		Flames.	Florins.	Flames.	Florins.	Flames.	Florins.
Flames.	Florins.	10	8	10	10	10	10
10	10	25	14	25	15	100	25
25	16	50	20	50	20		
30	20	100	25	100	25		
100	25			200	30		
				300	35		
				400	40		
				500	50		

In the schedule of prices for supply of current, it appears that Siemens requires no fundamental tax, nor does Schuckert. The Gas Company and the International require a fundamental tax of 2 florins, which in the case of the former ceases if the consumption exceeds 600 hours, and in the case of the latter if it exceeds 200 hours. All four firms give lengthy scales of discount. The Gas Company state that the price of lamps will be fixed every two years by agreement. Schuckert is willing that the consumer should procure lamps and carbons at pleasure.

Prices for Public Lighting.

Siemens.	Gas Company.	Schuckert.	International.
16-candle glow lamp 2 kreutzers per hour. 3-ampère arc lamp 9 kreutzers.	Same as Siemens, but the arc light is 1 kreutzer cheaper.	16-candle glow lamp for 1,500 hours, 30 florins; 6-ampère arc lamp, 1,500 hours, 220 florins. For greater or smaller consumption 1·8 kreutzers is added to, or deducted from, the above prices per hour glow lamp, or 12 kreutzers per day arc lamp.	Allow a discount of 30 per cent. for public lighting; 16-candle glow lamps 2 kreutzers per hour's burning; arc lamps 1·4 to 2 kreutzers. The installation of the lamps is charged separately.

Prices for Electric Motors.

Exceedingly complicated, especially according to the tenders of Schuckert and the International. Siemens excludes the evening hours from his scale of prices.

Unit of Light in all Tenders.

The amyl-acetate normal lamp.

Time required for building.

Siemens.	Gas Company.	Schuckert.	International.
1½ year from concluding agreement.	One year real time for building; winter months not included.	One year if beginning in Spring.	One year, after completion of process with Gas Company.

Security deposited, 10,000 ft. in each case. Reduction of prices promised for the future.

Reduction of prices in proportion to cheapness (?)	Do.	Do.	Prices will be agreed upon with the community for each five years.

It must further be remarked that the Gas Company promise a reduction of the price of *gas* for illuminative and motor purposes if their tender is accepted.

ELECTROSTATIC ALTERNATORS.

By T. H. MURAS.

SINCE my experiments on this subject, described in the ELECTRICAL REVIEW, Vol. xxx., p. 764, I have tried a machine having larger insulating spaces, but otherwise of the same general form as the old one, consisting of an ebonite disc, carrying tinfoil sectors extending inwardly from its edge on both sides, and rotating between fixed glass plates, which carry similar sectors on their outer surfaces. The frame is that of the old machine. The dimensions are as follows:—

Diameter of rotating disc	45·8 cm.
Thickness of " "	·63 "
Spaces between disc and glass plates, each	·28 "
Thickness of each glass plate	·28 "
Width and height of each glass plate ...	56 "
Number of sectors on " " " ...	10.
Insulating spaces	5 cm.
Radial length of each sector	9 "
Greatest width of each sector	9·1 "
Area of each sector	60 sq. cm.
Revolutions per minute, about 1000.	

Fig. 1 represents one of the glass plates, with its sectors and their connections. The size of the plate being insufficient to allow foil connections to be used as in the old

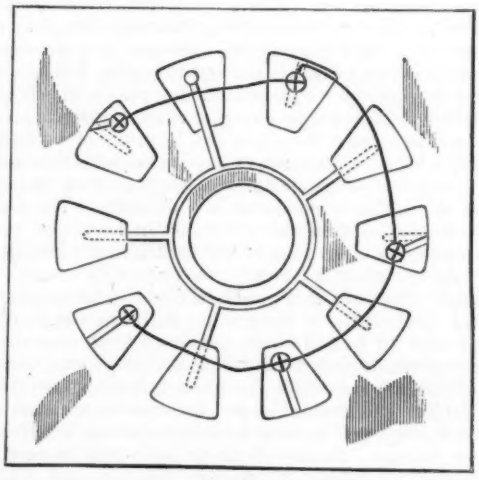


FIG. 1.

machine, some connections are made by gutta-percha-covered wires, supported on corks gummed to the sectors, short pieces of thin brass tubing being inserted in some of the corks to receive the ends of movable connecting wires. To prevent glow discharges between the frame and the sectors on the rear plate, another glass plate is interposed. All sparks for measurement were taken in air between brass balls, ·95 and ·84 cm. in diameter respectively, as in the former experiments.

The sectors on the fixed plates are charged by connection with a large Wimshurst machine, to as high a potential difference as possible without causing sparks between them, namely, that able to produce sparks 30 mm. long between the brass balls mentioned. The maximum length of spark obtainable from the alternator is then 3 mm., the length obtainable continuously being only 2·4 mm. Sparks are obtained at these distances more easily when no Leyden jars are connected with the Wimshurst machine; this result agreeing with experiments on the 40-section alternator described in my former paper. The capacity of the machines and connections appears to be sufficient for the working of the alternator, and the addition of jars appears to facilitate brush discharges from the field sectors. On stopping the Wimshurst machine, the discharge from the alternator ceases in two or three seconds, and after about ten seconds recommences, and continues for some minutes, the action of the alternator being, however, reversed, so that parts of the field plates which formerly induced positive charges now induce negative ones, and *vice versâ*. The field sectors themselves may be completely discharged during this time, without interference with the discharge from the alternator.

These effects are due to charges received on the inner surfaces of the glass plates from the disc sectors, quantities of faint sparks being visible between these parts in a darkened room. The charges so received partly neutralise the action of the oppositely charged field sectors, the electromotive force producing the discharge from the alternator being thus limited, so as to render it unsuitable for the purpose for which it was intended. The effect is the same as that tending to produce reversal in Holtz machines, and was anticipated to some extent, but is worse than was expected. Apparently it could only be overcome by placing the disc and fixed plates sufficiently far apart in air, or perhaps in a compressed gas, to prevent discharge between them, and this would necessitate a considerable increase in their dimensions. In such a machine the fixed and moving sectors might be directly opposed, without intervening glass surfaces. The reversing and after effects do not appear at all in the 40-sector machine, in which the potential differences are less, and the air spaces greater than in the present one.

Other methods of preventing the reversal effect appear to involve serious leakage from the charged sectors. The disc sectors may for instance be charged to produce a rotating field, but the output of the machine is then even less than before. The machine might be immersed in insulating oil, this being confined in some way to prevent the machine acting as a centrifugal pump, the device involving considerable mechanical difficulties; but currents of oil would carry charges from the sectors, either to partly neutralise those on other sectors, or to produce the reversing effect, the result depending on the amount of circulation of the oil.

It thus appears that while such alternating machines can be worked satisfactorily with comparatively small differences of potential, and may be useful for laboratory purposes, they are practically useless for giving high potentials directly.

One or two constructive details may be useful to other experimenters. Paper field sectors were tried, in contact with connecting strips of foil, shown in fig. 1. They were cut from thin writing paper, and gummed on the varnished glass plates. They permit a somewhat higher difference of potential to be maintained between the sectors, sparks 3 mm. long being produced continuously when using them; but no

FIG. 2.

longer ones were obtained. For cutting sectors, I find it most convenient to use patterns made from zinc thin enough to be cut accurately with strong scissors; zinc is in every way the best material for the purpose, and after being so used is still useful in a laboratory. For terminals on coatings of plates, the knobs illustrated in section in fig. 2 are used, holes being provided in them to hold the ends of connecting wires, brush discharges therefrom being thus prevented.

They are made from ornamental nails having round brass heads, A, 1·7 cm. in diameter at the base. The shank is cut short and filed level with the head. Two holes are made in the head by a small punch driven from the inside, the head being supported on a lead block, and the edges of the holes are afterwards filed smooth. A bevelled disc, B, of cork, is then cemented in with shellac varnish. Such terminals may be secured on flat tinfoil surfaces with common gum, the surface being placed horizontally for a day or two until dry. For connections, copper wire covered with thick gutta-percha is the only means obviating glow and brush discharges.

ELECTRIC LIGHTING AT THE CASTLE OF FRÖSCHWEILER, ALSACE.

[FROM OUR OWN CORRESPONDENT.]

AT the pretty country seat of Count von Dürckheim-Montmartin there has recently taken place the formal opening of an electric installation which, though relatively small, is very interesting on account of its execution and its application. The former manufacturing establishment at Liebfrauenthal, near Woerth, which fell a year ago into the hands of Count Eckbrecht von Dürckheim-Montmartin, has been converted by him, from a ruin, into a charming place for country excursions. The old inn has been renovated and the garden around it beautified. The most interesting feature, however, is the application of the existing water power to supply Fröschweiler Castle with electric light and electric power as well as with water.

The works consist of distinct parts :—

1. The primary station at Liebfrauen that is used for producing the electric current by means of a turbine of 35 H.P. which actuates three dynamos. The smallest of these serves to light up the machine station, the inn and the forester's house, whilst the two larger dynamos furnish the current for conveyance to the pumping station and the castle.

In the well-fitted machinery house there is a finely-executed switchboard with the necessary apparatus for regulating and measuring the current. On the switchboard there are also the lightning protective appliances for the uncoated leads.

2. *The Leads.*—Leads of bright copper supported on wooden poles conduct the current from the primary station at Liebfrauenthal to the secondary station in the castle. In all 24,000 metres of bright copper wire are in use. The main conductor is 7 mm. in diameter. The chief supports carry six leads. Two are for supplying current, two for the measuring instruments in the machine house, one for the telephone lead, and one bristled wire as a lightning protector. The leads are calculated for a maximum tension of 320 volts, and the loss of tension is 20 per cent. on a current of the strength of 29 to, at most, 34 amperes. All the leads are protected against lightning by means of lightning boxes at the end station. In addition, there is a double safety for the entire range of supports afforded by the bristled wire, which is extended at the tops of the poles along the whole line, and is connected with earth at the ends and at various intermediate points.

3. The secondary station in the castle consists of a well fitted switchroom with instruments for regulating, measuring, &c., for working the accumulators and motors. In the same room there is also a telephone station from which it is possible to speak to several different places. Particularly interesting are the automatic cell-switches which keep the tension in the light conductions constant with a wonderful precision. A battery of accumulators is established in a room next the switchroom. It contains 120 cells on the Tudor system of the capacity of about 200 glow lamps for five hours, or 280 glow lamps for 3½ hours.

From the secondary station the current is distributed over the whole castle, for use in the most varied manners. To work household machinery there are two electromotors each of 2 H.P. The total requirement of water for drinking and other uses is supplied by electric agency. The water is furnished by a spring in the Langensulzbach wood, about one kilometre from the castle. From the springs the water is conveyed by pipes to the reservoirs of the newly erected pumping-house on the Langensulzer road, and thence it is forced up by two pumps to the castle, which stands high. Each pump is connected with a 2-H.P. electro-motor by means of friction wheels.

For lighting, an extended net has been installed in the entire castle, the offices and the park. A three-wire system is carried to the most distant points in order to obtain the proper tension. About 500 glow lamps and six arc lamps at 10 ampères (= 1,000 normal candles) and two arc lamps at 20 ampères (= 2,000 normal candles) are connected.

The effect is enhanced by the artistically elaborated fittings. The arc lamps are supported by candelabra and arches of wrought iron, and in the rooms of the castle a wonderful effect is obtained by means of gilt and silvered candelabra and others of crystal glass.

We must not omit to notice the manner in which the leads have been introduced in the rooms. No soldering, no leaden joints are perceptible. All such arrangements are placed in polished niches in the corridors.

Care has been taken to provide all the conveniences which can be furnished by the aid of electricity. There are electric cigar and pipe lighters, electric sewing machines, water boilers, and even an electric plate-warmer in a room next to the dining hall.

THE ELECTRICAL HABITS OF IRON.*

IT is strange how little is known about the loss of power in iron under reversals of magnetisation. It has been known for many years that energy was lost when iron was magnetised and demagnetised, but the builders of dynamos had no clear ideas on the subject. Seven years ago Prof. Ewing and Dr. Hopkinson called attention to the loss of energy by hysteresis, apart from Foucault currents; but since then no information of any practical importance has been added. It seems as if everything connected with alternating currrents is doomed to go through a period of barren quasi-scientific treatment before being studied and utilised by electrical engineers. The quasi-scientific method of treating iron is to take curves with a ballistic galvanometer. This is a cumbrous method, and does not give the information required. The engineer really wants to know what kind of iron gives least loss by hysteresis, what maximum induction does it pay best to employ, and how much energy is wasted per cubic centimetre per cycle. To test a given sample the obvious way is to make a little choking coil of it, and to measure the power lost by means of a wattmeter. This gives the information at once as regards that sample. If readings are taken at different electromotive forces, the losses at different inductions are obtained. The ballistic galvanometer method is merely an indirect and perhaps inaccurate way of arriving at the same result. Finding the qualities of different samples is a very small matter. The chief difficulty is to find good qualities of iron at reasonable prices, and what is wanted is the knowledge of the causes that go to make iron and mild steel good or bad. Makers of iron do not generally know anything about hysteresis, and electricians know little about iron, but it is no use shirking the subject and reading papers to scientific societies about curves belonging to specimens obtained at random from unknown sources. Reams of paper have been covered with researches on curves of random samples, and they are absolutely useless. They may be of scientific interest; if so, well and good, but they are generally supposed to be for the benefit of the benighted and ungrateful practical man. So far all the information the dynamo maker has is that soft iron has comparatively little loss by hysteresis, and he pins his faith on some particular merchant who supplies him with a metal which he calls "best Swedish charcoal iron," but which is not generally labelled "Made in Sweden."

A few investigators have given the analyses of their samples; but we do not know whether the percentage of carbon is the salient quality, or whether minute traces of other substances increase or decrease the loss of power. Neither do we know how the treatment of the iron in rolling and annealing affects the magnetic properties. If investigators could only be induced to consider what practical people want to know, instead of what "looks deep in print," some useful information might be obtained.

* *Industries.*

ELECTRIC TRACTION DISCUSSED AT THE CLEVELAND CONVENTION.

REGARDED from the social point of view, the recent Convention of the American Street Railway Association has been a great success. It was thoroughly representative, and the exhibits were as numerous as interesting.

The papers read, however, or, as the Americans term it, "the reports of special committees," did not come up to the average standard of such contributions. The report on "A Model Electric Street Railway Road-bed and Underground Wiring" relates chiefly to the merits of various types of rails, and the methods of fixing them in the roadway. Even the best of these do not come up to the average English practice in the permanent way for tramlines, therefore we need not dwell upon this portion of the subject. Underground wiring for the completion of the return circuit is touched upon in a general way, and, as usual, a No. 0 soft copper wire is recommended, which is joined by No. 6 copper wires to the steel rails. It has been found that during dry weather there is generally more energy used than during wet weather. This is not attributable to the moisture of the earth alone, but also to the fact that the dirt and dust is washed off the rails, thus reducing the resistance between the wheels and rails forming part of the circuit. Watering the rails offers desirable advantages. This has been pointed out many times by Reckenzaun, who carried out comparative tests several years ago.

Mr. O. T. Crosby presented the report on "Standards for Electric Street Railways." A similar communication was read at the Convention a year ago. It relates to uniform methods in keeping accounts and tabulating operating expenses. Much stress is laid upon the standardising of specific dimensions of important parts of cars. The following standard dimensions are suggested:—Diameter of axle, 3½ inches; of axle journal, 3 inches; length of axle journal, 8½ inches; diameter of car wheel, 33 inches; weight of car wheel, 350 lbs.; diameter of trolley wheel, 4½ inches; width of trolley wheel when new, 1½ inches; depth of groove, 1½ inches; and the distance between hubs of wheels, 48 inches.

Concerning *nomenclature*, the author gives the definitions of words used in electric railway engineering. As regards the method of *rating motors*, two terms should be used; one giving the horse-power of the motor at which it can work continuously at a safe temperature, the other its maximum horse-power.

"Standardising of Accounts, Accounting Methods and Statistics," forms a separate subject, dealt with by Mr. H. I. Bettis. In the *division of expenses* there should be the following sub-divisions:—1. Transportation expenses, comprising the wages of conductors, drivers, motormen, lubricants, &c. 2. Maintenance, giving the expense of keeping the properties in their original condition, and relates to repairs of track, buildings, cars, power plant, &c. 3. Construction expense, such as is added to the value of the original plant, such as additional buildings and machinery, less the value of old ones taken up. For the *unit of comparison* the *car mile* is again suggested, yet this is unsatisfactory, unless statistics are accompanied by a statement of the nature of the road and the size of the cars, &c.

The report on "Relative Cost of Operation of Horse, Cable and Electric Roads," reveals some curious characteristics. Comparing an average cable road with an average electric road, both located in the same city, both of the same magnitude, fuel and labour costing the same in each, and neither using trail cars, some interesting figures are obtained. The investment in each case is up to the average, that is, is not extravagantly large, and yet ample for the business transacted. Each road may be regarded as typical of its class. The cable road has ·85 penny greater fixed charges per car mile than the electric. The gross receipts of the cable road are one halfpenny larger than in the electric road; but, resorting to the comparison by "figure of merit," the ratio is nearly as 3 to 4 in favour of the electric road. The total investment in the case of the cable road is 2⅛ times the total investment of the electric road. The committee states that 89 per cent. of the electric roads in the United States report dividends of from 5 to 12 per cent. They believe that cable road practice has reached the stage where but little room is left for improvements. They have been developed, improved and operated by the best engineering skill which the country affords. But whatever the past experience of the two systems has been, or whatever the present status of the two may be, the reporters are only voicing the convictions of well-informed engineers, when they say that the electric systems will continue to increase in efficiency until all rivals are distanced and only one method of rapid transit is recognised—the electric car.

"Economy of Machine Shops for Electric Street Railways," reported by Mr. J. H. Bickford, calls for a few comments. The author endeavours to ascertain whether there is economy in maintaining a machine shop when there are so many manufacturing and supply companies which can furnish every conceivable thing at short notice, and the local machinist stands ready to do the work at a price varying from 50 to 75 cents per hour for first-class workmen. In order to arrive at the results obtained, the author sent out circulars requesting information on various points, and received replies from 66 companies operating electric roads. Among the answers he found many things to strengthen his belief that it is economical to maintain a machine shop, not only for repairs but for the manufacture of supply parts. It turns out to be a fact that no less than 24 roads are maintaining machine shops, doing all their own repairs and manufacturing supply parts. They say, unhesitatingly, that there is economy in so doing. Their reasons are: First, that they can *make* better material than they can *buy*; that they are perfectly familiar with the requirements and conditions of the business; they are operating roads and are in a better position to know just what is needed, and are better able to judge of the strength and durability of the apparatus than those who have never been in a similar position. The author did not mean to cast reflection on the earnest efforts of the manufacturers, but he must say from personal experience that there was much material on the market to-day that was not up to the standard. There is a saving of from 25 to 50 per cent. by manufacturing the majority of parts. A thoroughly equipped workshop is recommended; also a thoroughly competent electrical engineer, not one of the self-styled "electricians," but one who has theoretical and practical knowledge of mechanical and electrical engineering.

In the report entitled "A Perfect Overhead Electric Construction," read by Mr. Ch. K. Smith, there is not a single passage affording information which cannot be found in old papers bearing on this subject, and which is not better treated in the existing books on electric traction.

The discussions of the various reports were short, and of comparatively small importance as regards facts elicited.

THE INDUCTION MOTOR: WHO INVENTED IT?

BY RANKIN KENNEDY.

THIS question has been keenly discussed recently by Tesla, Stanley, and Kelly, in the New York electrical journals.

In the *Electrical World* of October 8th, Mr. Tesla discusses the question of the relationship of the type of induction motor invented by myself and that invented by him, and with much skill makes out that my motor and his are similar in principle and in action.

Then in the same journal, October 22nd, Mr. Kelly claims for Mr. Stanley the invention of the motor which I describe as mine, and points out that the Tesla motor is quite a distinct type from that described by me.

Quite recently, I gave my opinions regarding Tesla's claims in these columns, and I may here repeat that I am not at all concerned about the result of the contest over the claims to the invention. I may have been anticipated by Stanley and Tesla, but I contend that my motor is a distinct step in advance, and a very considerable improvement on the Tesla motor. I admit my motor springs directly from Tesla's, but in it some of the objectionable features of the Tesla motor are abolished and several quite novel features are introduced, so that although it may come under the broad claims for an inductor motor, it is none the less a step onwards towards a perfect motor, and as such, I claim the credit due as its inventor.

The difference between the two motors under discussion somewhat resembles the difference between an open coil arc dynamo and a closed coil constant pressure dynamo; the fundamental principles of construction and action are the same in both, but the machines have many striking differences in their action.

To make the construction of the two motors clear, I have constructed two simple models illustrating a Tesla and a Kennedy induction motor, and showing their difference; diagrams of these models are here shown. figs. 1 and 2.

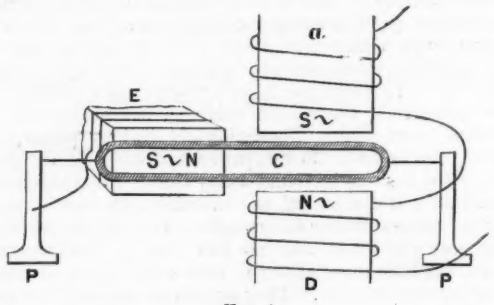


FIG. 1.

In fig. 1, *c* is a coil of copper closed in itself, either one turn or many turns may be used; it is pivoted on P, P, so as to turn freely on an axis. This coil lies between two field magnets at right angles to each other. A, D, are the two poles of one of the magnets, and E is one of the poles of the other magnet, the opposite pole being removed to show the coil, *c*, in the positions shown. It will be clear that the magnetic flux from the magnet, E, flows directly through the coil, while the flux from magnet A to D does not flow through the coil. It will now be plain that that part of the coil opposite E will act as a secondary generator, and a powerful current will be set up in the coil, which flowing round, acts as a motor current between the poles, A, D. It will be seen that the position of the coil between the poles, A, D, is that in which it acts most powerfully as a motor. Now, as the coil moves on its axis through a quarter of a turn, that part of it between A, D, becomes the generator, and the part between magnet, E, becomes the motor, and so on the action goes producing a torque, which is not steady, but has four maxima and four minima in each revolution.

This is a Tesla motor. It requires two alternating currents in quadrature phase, one to excite the one field, and the other to excite the other field; quadrature phase is necessary, owing to the currents lagging behind the E.M.F. If the two exciting currents were in the same phase, then the current through coil would not coincide with the magnetic maxima across the field, which, at that moment, was acting as the motor, and there would then be little or no torque; the maximum current in the coil must coincide with the maximum magnetic flux across the motor field; in other words, the phase of the *current* in the coil must be co-phasedly synchronous with the phase of the *magnetic flux* in the field acting as the motor at any moment.

If the various steps of induction are followed out, and their lag taken into account, it will be quite clear that quadrature exciting currents brings the current in the coil into phase with the magnetic flux in the motor field.

This explanation says nothing about rotary poles. The author considers the rotary polar theory as a very pretty fiction upon which the action of induction motors was built up by mathematical processes.

Any theory which does not begin with and follow up the simple fact that in all motors the torque is due to a current in a coil placed in a magnetic field, is humbug. To analyse the action of any induction motor, it is only necessary to trace the path of the magnetic fluxes and their relation to the coils carrying the induced currents; if this is done, it will be found that they are acting as ordinary continuous motors do, and that there is no necessity whatever for any rotary polar theories to explain the torque.

One would have thought that the very idea of poles acting, had been abandoned long ago, when the idea of the closed magnetic circuit was adopted as the guide in all dynamo and motor designs. The rotary polar theory, as based on the action between magnetic poles is, therefore, misleading, because all motor action in motors having ring and drum armatures is due to the forces acting on the current in the wires in the magnetic field; the poles govern only the direction of the forces, the magnetic flux and the current alone set up the forces.

The models here described are easily made, and very nicely teach many lessons on induction.

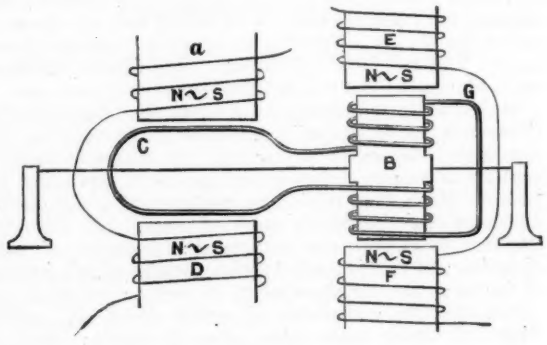


FIG. 2.

The author's motor is shown in diagram (fig. 2). Here, again, we have two fields, A, D, and E, F, excited by currents alternating in quadrature. Now, note the difference between this and Tesla's motor; the coils in Tesla's motor act at one moment as a motor, at the next as a generator. In this motor the coil, *c*, acts continually as a motor coil; it forms part of a closed circuit with a coil, G, which is wound on a laminated core, B; this coil, G, acts continually as a generating coil, furnishing the current for motor coil, *c*. The generating part and the motor part are distinct and separate; the field, A, D, and coil, *c*, form a motor, while the field, E, F, and coil, G, form a secondary generator; G being the secondary to the primary wires on the magnet, E, F. It will now be plainly seen wherein the difference of construction lies. Now, for the difference in action: in the Tesla the same coils act alternately as motors and generators, and, as they are carried through the field, reactions take place which have never been, to my knowledge, made clear, but everyone knows that counter E.M.F. is set up in a motor coil; in fact, besides the E.M.Fs. set up in the coils by the alternating magnetic fluxes, there are E.M.Fs. set up by the motion of the coils in the field, and these very much complicate matters in the Tesla motor.

In the author's motor the generator part acts only as a secondary to the primary on the field, E, F, the coils represented by G are in the actual machine wound on a laminated

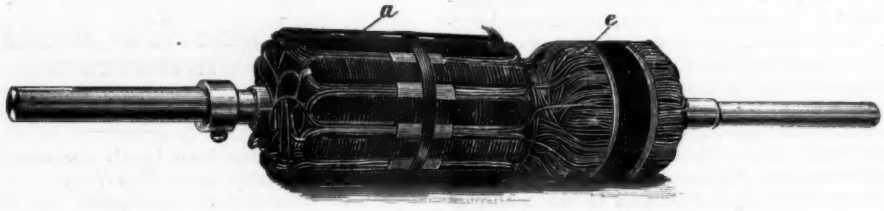


FIG. 3.

core having projecting teeth, as shown clearly in figs. 3 and 4, reproduced here from page 661, May 27th, 1892, ELECTRICAL REVIEW. Now, such a core and coils revolving in a two-pole field can have no E.M.F. set up due to the rotation in the field; the only E.M.Fs. set up in the coils are

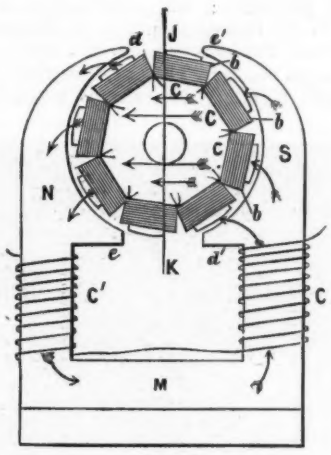


FIG. 4.

due to the alternating magnetic flux; this very much simplifies matters, and is a very decided improvement on all other induction motors.

The induction motor is only in its infancy. As now made they are not yet fit for introduction into practical work. Some inventor must perfect the induction motor; but if he is not prepared to meet the charge of infringing Tesla's claims, he will have to keep his improvements to himself, as Mr. Tesla claims that his patent covers all induction motors. More's the pity.

THE NEW WESTINGHOUSE LAMP.

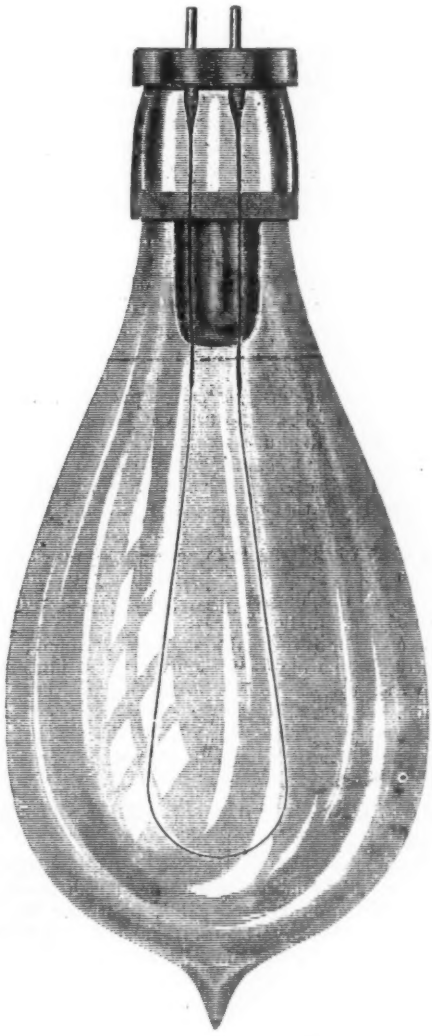
WE are able this week to give an illustration of the new lamp to which we briefly referred the week before last, together with the following general description, our authority being the *Western Electrician*.

"There is no brass at the base of the lamp, the butt being of glass. No platinum is used for the leading in wires, its place being taken, it is said, by an alloy which is claimed to be a satisfactory substitute, and to have a proper coefficient of expansion. The nature of this wire composition is, of course, kept secret. The lamp is a separable one—that is, the filament can be removed and the bulb used over again. This is accomplished by attaching the burner to a ground glass stopper, which is tightly inserted in the bulb. Then, after (? before) the air is exhausted, the lamp is sealed by a peculiar brownish paste. To remove the filament the lamp is soaked in hot water, which softens the sealing compound and allows the removal of the stopper, which, when refitted with a new burner, can be replaced in the manner described, it being necessary, of course, to again have recourse to the pumping process."

It thus appears that there are three leading differences in its construction to the usual form of lamp:—the leading in wires of a special alloy in the place of platinum, a stopper, and a cement. The use of a stopper and cement instead of the method of "sealing in" with the blow pipe, has, of course, been frequently suggested and tried, but hitherto without commercial success; so that if the Westinghouse Company has succeeded in devising a really economical and efficient plan it deserves distinct credit. The adoption of this mode of manufacture, together with the use of a substitute for platinum wire, should certainly render the company exempt from the claims of the Edison patent as regards the strict letter, although, perhaps, hardly from the spirit of the patent. The spirit of the Edison claim is well expressed in the following enunciation which emanates from the American Court of Appeal.

"The combination of carbon, filamentary or thread-like in size and properly carbonised, used as an illuminant in an incandescent electric lamp, with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air has been exhausted to such an extent that disintegration of the carbon, due to the air-washing action of surrounding gases, or to any other cause, is so far reduced as to leave the carbon practically stable."

From a manufacturing point of view, which is of far more real importance than any mere legal rights and quibbles; there are several points which, at first sight, at any rate, appear to be in favour of the modified lamp, but there are also many "if's" requiring to be satisfactorily disposed of. In the first place, it is difficult to see how *new* lamps of the



above form could compete successfully against those made by the extremely simple and efficient method of "sealing in," in spite of the employment of a cheap substitute for platinum wire, and in spite also of the assertion that they can be sold for 30 cents each wholesale; for there can be no question that the new form is much more complicated than the present one. Once made, however, they possess some obvious advantages from an ideal point of view. In remaking a lamp there is at once an apparent gain of the cost of the bulb and platinum wire—indispensable items in making lamps by the customary method. (This is, of course, assuming that the double operation of removing and re-cementing the stopper to cost the same as that of sealing in by means of the blow pipe.) This gain, however, is not strictly so great, for scrap platinum has a certain value, and then there has to be considered, the wholly additional operation of cleaning the blackened bulbs, requiring workshop space, chemicals, labour,

&c. Still, if the bulbs and stoppers had a good average life, the advantage would be distinctly in favour of the stopper plan, other things being equal. But it is just on this point of the life of the bulbs that the economy of the plan rests, and on which we think there are some grounds for fear. One would be inclined to surmise that the number of fractures occurring at the stoppers, firstly in the act of fitting the stoppers, then when the lamps are on the pumps, next in actual use, and finally in the operation of removing the stoppers, would considerably exceed those due to defective "sealing in" in the customary form of manufacture. Quite a small percentage of additional fractures in the bulbs in completed or nearly completed lamps would tell very adversely against any method of manufacture, even if very appreciably cheaper. Efficiency, as a rule, is of far greater importance than mere cheapness, and the rule certainly applies to lamp manufacture. Another source of loss, through fracture of bulbs is likely to be occasioned by the repeated operation of joining the exhaust stems on to the old bulbs and sealing off the lamps, owing to the glass becoming unannealed. New glass may be quickly and easily joined and worked, but it is not so with glass that has been frequently heated and cooled. Constant practice at the operation, however, is likely to reduce the loss from this cause to a comparatively insignificant amount.

The only other feature in favour of renovating old lamps is that no preparation of fresh wires is needed, but this advantage would probably be more than counter-balanced by the trouble and cost of transporting the old lamps back to the factory, and by the operation of clearing away the old mounts. All the rest of the processes of manufacture would remain exactly as at present.

In making the above remarks we have been assuming that the stoppers and cement give perfect satisfaction as regards permanence of vacuum. Naturally if leaks prove to be not unfrequent the method under consideration would be at once doomed. The matter naturally rests entirely upon manufacturing results and general experience with the lamps, and we are glad to see that the problem is being dealt with in so exhaustive a manner as the Westinghouse Company are sure to give to it. At the same time we cannot help thinking that the new plan is not likely to supplant the present one in the long run, excepting, perhaps, in the case of lamps of large candle-power.

With regard to the substitute for platinum, which is apparently capable of being soundly sealed into glass, the company is to be congratulated on a very valuable possession.

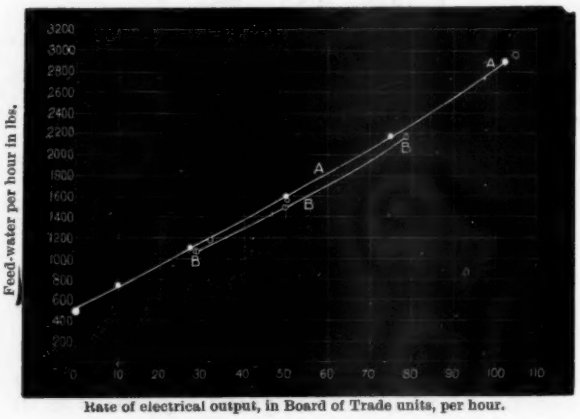
PARSONS STEAM TURBINE TESTS.

It speaks a good deal for this steam turbine that it has been selected as the motive power for the alternators to be employed at Cambridge for public lighting. It has also been adopted in many steamships, and at some important isolated electric lighting plants. From these facts it may be taken that the Parsons steam turbine is at least able to compete successfully with the cylinder and piston engines.

In a recent report just issued by Prof. Ewing, of Cambridge, several tables are given, and statements of results of tests made, which show that the economy of steam in this turbine is remarkably good, the general result being a consumption of 28 lbs. of steam per electrical unit at full load, and 32 lbs. at half load; that is equal to a consumption of 15·7 lbs. of steam per *indicated* horse-power per hour at full load, and 17 lbs. per horse-power per hour at half load. These figures show a decidedly apparent improvement on the turbine tests made in December last, resulting in a saving of at least 10 lbs. of steam per electrical unit.

The methods of testing the consumption of steam, and in ascertaining the advantages due to superheating the steam, are, however, open to some question.

At the very outset of the report, the trials made in December without any superheating are referred to, and the general result stated. Then the report on the recent tests begins with the statement that they were undertaken, first, to ascertain how far the efficiency had been increased by recent changes in the turbine, and by the use of superheated steam. The same turbine was used as had been used in the December tests, but it had additional rings of blades added, it had a larger air pump, producing a better vacuum, and it had an improved governor. The result of all these changes in construction, and the use of superheated steam, are given in the four tables annexed to the report, and the economy comes out as stated previously; but, how much of the improvement is due to the increased number of blades, how much is due to the improved governor, and how much is due to the use of superheated steam? These are questions upon which this report says nothing. No table is given showing the



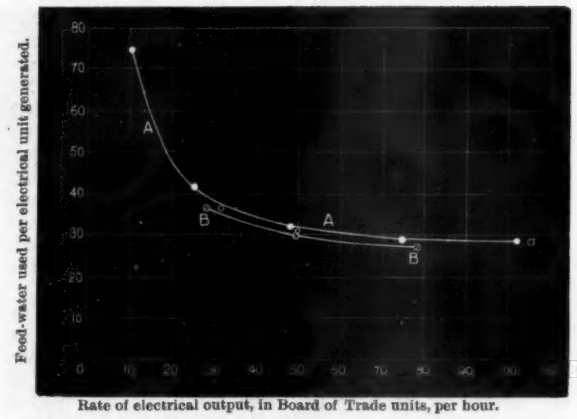
Rate of electrical output, in Board of Trade units, per hour.

Trials of Parsons' steam turbine and dynamo, August, 1892.

A A, Steam superheated to about 400° Fah.; Continuous current trials, ●
Alternating current trials, ○ B B, Steam superheated to 465° Fah.
Continuous current trials.

tests of the improved turbine under ordinary saturated steam, so that it is impossible to say whether the superheating was really any gain at all. Surely it was worth while testing the altered turbine under ordinary steam to ascertain whether the addition of the blades, and the different system of governing, gave any higher efficiency under ordinary steam; then, with the tables given, anyone could compute the gains obtained by the various alterations, and also the gain resulting from the use of the superheated steam. As the report stands, this cannot be done.

It is no use referring back to the December tests, for the results with ordinary steam, in these tests, the turbine had fewer blades, a faulty governor, and too small an air pump, and the injection water was admitted at a point too far from the turbine.



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Alternating current trials, ○; B B, Steam superheated to 465° Fah.;
Continuous current trials.

By the omission of a test with ordinary steam the report loses a great deal of the value it otherwise would have had.

Another grave fault in this report is the omission to state the length of time the trials lasted; this is an important matter when the water fed into the boiler is made the measure of the engine's steam consumption, for, in a short

run, an error in reading the height of the water gauge on the boiler is a very serious matter, and the water height in a gauge tube is a difficult thing to measure, and also varies with the pressure in the boiler. An error in reading the gauge amounting to only $\frac{1}{16}$th of an inch would make all the difference if the run were only one hour; but if the run were 10 hours, it would make a tenth of the difference, and for other reasons it is important to have the duration of the run under test stated.

The tests made are important, as showing the efficiency of superheated steam at different temperatures, but they certainly do not show us how much better superheating is than ordinary steam. Be that as it may, the general results, even after allowing for errors in the method adopted in measuring the steam consumption, are excellent; no rotary engine or turbine has ever been shown to be so economical. This, coupled with the advantages of high pressure direct driving, explains the success of the Parsons turbine.

The new method of governing the turbine is worthy of notice, as, in our opinion, it contributes towards the economy. The steam is admitted by an equilibrium trip valve in puffs at full boiler pressure, the puffs being made shorter or longer according to the load; it is, in fact, an application of the Corliss automatic cut-off valve to the turbine. In the older turbines the steam was throttled—wire drawn—by the governor. Every engineer can appreciate the difference, in economy, obtained by governing by means of a variable cut-off, and by throttling. Parsons's new governor is an automatic variable cut-off, and hence the full boiler pressure is taken advantage of at small loads as well as at heavy loads.

The steam turbine is an old invention, many times to be met with in the Patent Office records in all forms. Their failure was no doubt due to their enormous consumption of steam. The Parsons turbine owes its economy in the first place to the use of turbines consisting of a number of wheels placed in series on one spindle, so that the steam flows first through one then through the other, delivering up a portion of its energy in each wheel. This is an old idea, and one which we think is imperfectly understood. In the Parsons and other turbines, containing wheels in series, the wheels are made with larger and larger passages and blades as they are nearing the exhaust end, the idea being to expand the steam, so that it will have little pressure at the exhaust end; the idea is, in fact, to apply expansion of steam, as is done in a piston and cylinder engine. Now there seems to be a fallacy here. A turbine wheel, taking up the energy of motion from a moving fluid, is acting on a totally different fundamental principle from that upon which an expansive fluid in a closed cylinder acts upon a piston. In the turbine, it is the energy of motion which is transferred from the fluid to the wheels. In the cylinder the fluid, as a whole, is stationary, and delivers its energy to the piston by expanding and losing its pressure, which lost pressure represents the work done. The construction of steam turbines, with a series of wheels having increasingly greater area of passages and blades as they near the exhaust, proves that this distinction between the turbine and cylinder and piston is not taken into consideration in designing them, because, if we are to take up the energy of motion, all the turbines in the series should be alike in size of blades and passages. Expansion through wider passages can only reduce the pressure and motion of the steam, without doing work. The totally different principles of action between a turbine and a cylinder and piston engine may be beautifully illustrated by braking a turbine, with full steam on, until it is stopped entirely; it will then consume the same steam as it did while doing full work, and yet it will be doing absolutely nothing (the turbine is like an electric motor in this respect). But if a cylinder and piston engine is braked to a stop, it does no work; but it consumes no steam when stopped by brake with full steam on.

The steam turbine, with many wheels in series, forms a series system, the principles of which are so well known to electricians. The fundamental requisites in a series system are, first, constant current (whether it be water, steam, or electricity); second, all the motors or wheels in the series work with the same current, that is, have the same sized passages for the current; and the number in the series must be varied directly as the difference of pressure between the two ends varies. According to this theory, the slower the speed required on the turbine, the more wheels must be employed. The number of wheels required to bring down the velocity of the steam flow to within practicable limits must be determined by experiment for each type of turbine.

The above suggestions are thrown out as hints to those engaged in turbine manufacture. If this theory has been tested, we shall be glad to have the results published.

In regard to the alternators used at Cambridge, it seems strange that they should be run on separate circuits. Even granted that the turbines are economical at half load, parallel running would be advantageous. No reason is stated for not working them in parallel; it would be interesting to know if there are any difficulties in the way of synchronising at high speeds.

The efficiency of the engine and dynamo combined comes out very satisfactorily. The total effective work done by the steam on the turbine was in one test computed to be 179 H.P. 75 per cent. of this appears in the external circuit of the dynamo, giving 25 per cent. as loss in engine and dynamo combined. How much of this is lost in the engine and how much in the dynamo cannot be ascertained from the tests.

Altogether, the report shows decided improvements have been made, and we congratulate the indefatigable inventor who has so perseveringly carried out so many important inventions in connection with the steam turbine.

MR. THWAITES ON THE DESIGN OF STEAM GENERATORS FOR HIGH PRESSURES.

IN describing his own type of boiler before the Mechanical Section of the British Association, Mr. Thwaites first utterly condemned hitherto existing methods of construction and design, and so at the beginning had a clear field wherein to construct his own ideal boiler. At the outset he claims that boilers have not kept up with the steam engine, and that, generally, land and marine boilers are not creditable to the engineering profession. We think Mr. Thwaites is going a little too fast. We are at one with him in deploring the marine boiler, with its nest of tubes directly over the furnaces, but we cannot admit that at the present day the design of, say, the Lancashire or Cornish boiler, is without evidence of thoughtful consideration. We could take Mr. Thwaites round a boiler of to-day, and round others of the years 1860, '70, or even '80, and in progress from one to the other, we fancy that had we the gift of speech, we could deliver numberless addresses explanatory of the differences between these same boilers which would go to prove that not only had the mischievous effects of expansion been clearly recognised, but steps had been taken to remedy such. Engineers cannot be too theoretical—we use the term in a customary sense, though not in a strictly accurate one—they are compelled to be the slaves of circumstances. We all know that the flat end plate of a Lancashire boiler is wrong, its form is wrong, its attachment to the shell is faulty, so is its attachment to the furnaces, and its staying is decidedly wrong. Nevertheless, we contend that the flat end plate of such a boiler is one of the finest examples of skilful adaptation of practical means to a certain end which can be found in mechanical construction. It is a good compromise, and it embodies the combined observations of a body of men whose experience has been gained by hard work. Mr. Thwaites makes far too much of the supposed evasion or neglect in design of the "molecular dilatancy of metals," "zones of temperature," "resistance to heat transmission," "variable coefficients of expansion," or "the phenomena that characterise the production of steam and argillaceous, calcareous or saline deposits," *et hoc genus omne*, which are the bugbear of the tyro in design.

That different portions of a Lancashire boiler are heated to very different temperatures is true enough, but that the end plates are exposed to the fearful strains imagined by our author is not a fact; but it would take too much space to fully explain how the design of an end plate is made to reduce the strains, due to unequal expansion, to a minimum.

We will quote one sentence for the benefit of boiler

experts, as we think it will be sufficient to show that the author thinks too widely upon the influences to which a boiler is subject. He writes :—

"Because combustion is merely a series of impulses; each impulse of action sets up a vibratory or pulsatory effect, which soon loosens the rivets, or produces fissures in the end flanges, but whether the rapid but incessant vibration sets up electrolytic action on the water or not it is unnecessary to discuss."

Quite so. "'Twere to consider too curiously to consider so," we might add.

When we are told that riveted lap joints are not suitable in the "zone of the influence of intense temperatures," by which we are pleased to think the author is of a mind to indicate the furnace, we feel disposed to ask him, especially as he seems to have some knowledge of Manchester, did he never hear of the late Daniel Adamson, of Manchester, whose flanged furnace seam, or one of the modifications of it, has been for years used to the exclusion of the lap joint in all first-rate boilers. Modern boilers have no double thickness of plate in the "zone" of greatest heat. How this precious word "zone" reminds one of that blessed word Mesopotamia. Mark Twain, in his tramp abroad, says that the German language is chiefly made up of *Schlag* and *Zug*, and the equivalent of *also*, and these terms may always be heaved in when at a loss for expression. So with zone. Teutonics use it in connection with railroad tariffs, military operations, &c., and here we have it red hot in boilers—a word suitable enough, doubtless, for a pedagogue, but quite out of place as used by our author, who appears to have written his paper in approved German, and had it done into English by the office boy, or how else can we account for "the provision of externally fixed and always visible water downflow trunks," or for "descensional waterflow, and calcareous-or-other-solid matter-depositing-trunk," or even for "the provision of a foreign-substance-depositing-vessel."

We must give a direct denial to the statement "that the maximum scale accumulation in any Lancashire or Cornish boiler is coincidental with the furnace crown."

Everyone who knows anything of such boilers, knows that the maximum deposit is on the bottom of the shell, where fortunately it can do least harm, or at each side of the median line, and towards the back end, around the end plate gusset stay.

Mr. Thwaites then proceeds to describe his own boiler, which he constructs with long coils of $\frac{3}{4}$-inch tubes, above the furnace; but we regret to note he has rivets in the "zone of the influence of the intense temperature" in more than one place, and that for a high pressure boiler he has a flat crown to the shell, though he could easily have had a dished crown; that he has an angle ring round the fire-box in the "intense zone," which will soon burn out, and that he has an objectionable kink in the fire-box, which will give him trouble, we fear, whilst his mud depositer is quite wrong, and will also be comparatively useless. Finally, there is no provision whatever for smoke prevention, and of all smoky boilers, the vertical is one of the worst, and Mr. Thwaites's vertical will, we should say, be one of the worst smokers in a smoky crowd.

We are sorry to appear ungracious, or unwilling to credit a new design of boiler with such merits as would at once condemn all existing types. Full of defects as are steam boilers, they nevertheless represent the combined knowledge and experience of some of our best practical engineers. In their efficiency, they are by no means so far behind the best productions of mechanical art as our author would imply. We believe the ss. *Britannic* is still beating her own fine record with her original boilers.

Fresh designs of boilers have come and gone, and not successfully displaced older forms which have grown up. Modern boiler construction has kept pace with pressures, and steel plates, impossible a few years ago, are rolled to-day with ease, while ribbed or corrugated furnaces have dispersed the fears which had arisen as to the limit of strength of cylindrical furnaces having been exceeded. The record of water-tube boilers is not free from disaster, and for land purposes the use of small bore tubes will be avoided, even if proved useful at sea in the limited space available in a torpedo boat. For electrical work—especially for traction purposes—boilers must have considerable heat storage, and this means they must have fair water capacity or they are apt to prime, to fluctuate excessively in pressure, and to make demands upon the attendants which render such attendance unnecessarily arduous. A boiler which may merit our highest encomiums if upon a steam fire engine, is for this very reason utterly out of place in almost any other situation. We should rather like to hear Mr. Thwaites explain wherein his designs of boiler are more accessible for thorough all-round inspection of every important part than a modern Cornish, Lancashire, or marine boiler. The setting, or "basis of repose," of to-day is such that corrosion upon the seatings, if present, can be detected readily; far more readily, indeed, than grooving or other forms of dangerous corrosion in the narrow water spaces of the designs put forward by our author.

There is, perhaps, no other piece of mechanical construction which, when carefully studied in the light of actual working experience, is so potent in dispossessing the would-be improver of his ideas, and bringing him to acknowledge the superiority of non-complex forms as is the steam boiler. Furnace gases do not, after all, appear easily worried out of their contained heat; they seem quite disposed to give it up to very plain surfaces, and even to resent a too early endeavour to rob them, by becoming smoky. Mr. Thwaites states so much which is true—even if he does so in a somewhat involved and laboured style—that we are disposed to regret he has not given himself to the construction of ordinary types, upon which he would, we feel sure, effect improvements.

ELECTRIC TRACTION ON THE SOUTH STAFFORDSHIRE TRAMWAYS.

At the present moment it would appear as though there would be in the next few months a decided fillip to electric traction in the Old World. In London alone there are no less than six projects which have to all intents and purposes received the approval of a Parliamentary Committee. In the provinces there is enough already done to convince one that the movement towards electric traction is serious enough to merit more than passing notice. Nor is it England alone which now recognises that electricity under certain conditions is the most efficient means of providing power for tractive purposes. Paris proposes to have a tubular underground railway. A line between Brussels and Antwerp is projected; there are several schemes in Germany spoken of with favour, and as far east as Siam a line is to be built operated by electricity.

Traction by Overhead Conductors in England.

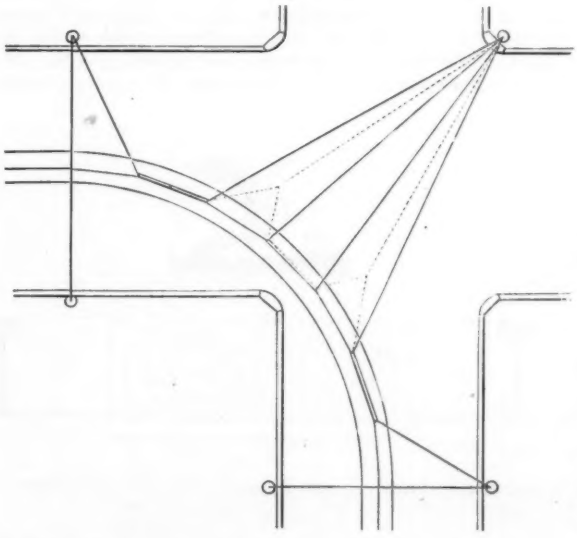
It may be fairly claimed that the overhead system has at last broken ground in England, and the successful working of the latest scheme should be sufficient to justify a rapid extension. Hitherto there have been two attempts to introduce overhead electric traction in England, notably at Leeds and Bradford. The Thomson-Houston Company, through their representative, Mr. Graff Baker, have been operating a three-miles section of tramline for many months. Though we believe this experiment has been a success, the tramway authorities of Leeds have shown little disposition to extend electricity to other parts of the system. Still, much of the awakening to the value of overhead traction is due to the success of this small line. English tramway men have for years watched the progress of electric traction; they have not looked upon it with jealousy, but as a possible means of reducing the heavy cost of horse traction. But the adoption of the overhead system of traction in England has hitherto met with most deep rooted prejudices. Local authorities have set their faces against it. The public have not been slow to imbibe the same prejudices, with the consequence that opposition has practically tabooed all systems of overhead traction. We believe the main source of this opposition arises from the fear that the general beauty of the streets may be impaired by wires and standards. They would, indeed, be ugly standards which could detract from the contour of Gray's Inn, Clerkenwell, and Caledonian Roads. Reduced, then, to practically two methods, inventors

turned their attention to improving accumulators or devising some underground system. Many have been the schemes submitted, but scarce one seemed likely to become of practical use. Two or three projects have had fair trial, and under special conditions have reached a certain measure of success, but, generally speaking, there was nothing in the experimental results which led tramway managers to be sanguine of their ultimate success.

With the failure of accumulator and conduit systems generally, we had practically reached, with regard to tramways, a comatose condition. On the other hand, American engineers had long ago concluded that there was at present little to be hoped for from the accumulator or conduit systems, and they turned the whole of their energy to the overhead system. They were not hampered much by local authorities; broadly speaking, they slung their wires anywhere and anyhow. So long as the car moved at a good quick rate and cost less per car mile than the old systems everybody was satisfied. Of course, in America there was little outcry against the desecration of the street by the standards and the wires. Perhaps they sensibly considered that the streets were made to facilitate transit and not with the object of appealing to the higher and artistic feelings of the inhabitants. Notwithstanding, however, that they had little interference, the progress in America has been really marvellous. The latest available figures show that there is no less than 3,600 miles of tramways with probably 7,000 cars, and nearly the whole of this has been completed within the last five or six years. There is no question, if figures mean anything, that the overhead system is, all things considered, the cheapest tractive force for tramways. The working of electric roads cost much less than that of horse, and the initial cost of equipment is so far below that of cable that, where possible to adopt electric traction, it would be folly to do otherwise.

AN IMPROVED OVERHEAD SYSTEM.

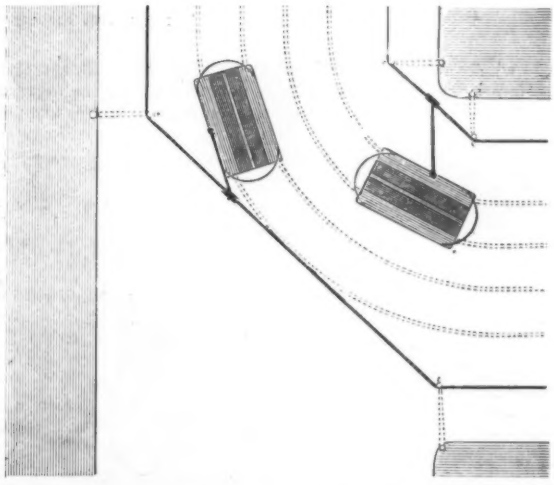
The fact, then, that the South Staffordshire Tramways had decided to adopt the overhead system of electric traction on a considerable portion of their system was of the utmost importance. The action of the directors was significant, because it was practically a recognition of the advantages of electricity compared with those of steam. The working expenses on this line have always been heavy, and the chairman, Mr. Carruthers Wain, and Mr. Dickinson, the general



AMERICAN SYSTEM OF STAYING A CORNER TROLLEY WIRE.

manager, early began to consider schemes which seemed to offer a less expensive car mile. In fact it was at the instance of the company that Mr. Dickinson and Mr. F. Brown, electrician to the Walsall Corporation, some time ago made a tour through the United States for the purpose of reporting upon the electric railroads. We may take it that this trip was to a certain extent satisfactory. Still, the ordinary system of overhead arrangements was by no means applicable to the South Staffordshire lines. The bracket system was out of the question, because the track was in the middle of the road, and to adopt the method of span wires and stays would have been too costly on a line which has a very heavy percentage of curvature. It has always been one of the first necessary features in an overhead system that the working conductor or trolley wire should follow with extreme nicety the curvature of the road, and hence we have the number of cross wires and stays which preserve the conductor at its proper angle. The American system of staying a corner trolley wire is shown in our first illustration. The Sprague Company, of America some years ago endeavoured to surmount this difficulty by using a T-shaped collector which was mounted on a flexible joint. It thus pressed against the conductor and allowed a variation of some feet from the absolute curve of the road. There were many objections to this method, however, both from sparking and the wearing of the conductor, and when revived by the Siemens Company at the Frankfort Exhibition last year, it was not altogether successful. Considerations such as the foregoing had to be met before overhead traction was practicable in Staffordshire, and gradually Mr. Dickinson evolved a modified system on the bracket principle, which we propose to describe in this article.

Before going into the details of the system it will be well to preface our remarks with some account of the South Staffordshire tramways. These tramways having a mileage of 23 miles are among the most important steam tramways in England. They practically fulfil the duties of a local railway between Walsall, Wednesbury, Darlaston, West



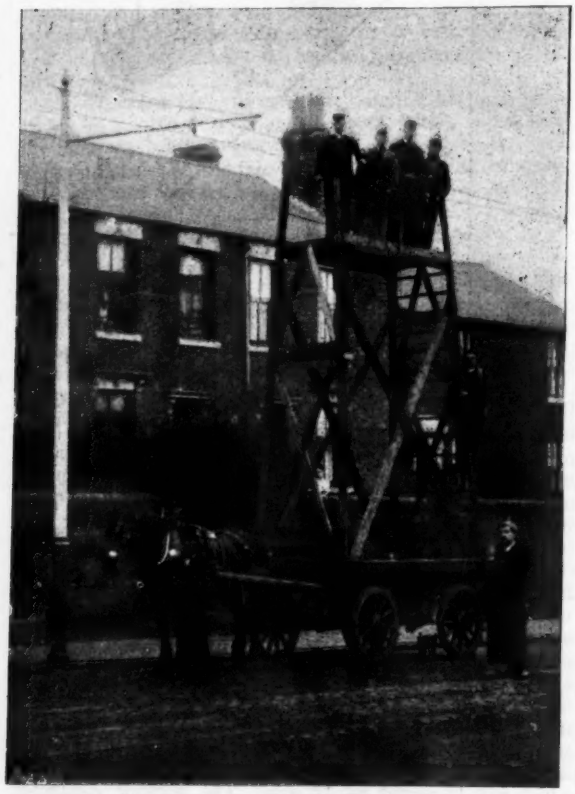
CARS ROUNDING A CORNER ON THE STAFFORDSHIRE METHOD.

Bromwich, and other places in the neighbourhood. Some four million passengers are annually carried between these places, but, as previously pointed out, the cost per car mile is heavy. Very sharp curves and most severe grades are traversed on all parts of the route, the grades being in many cases as much as 1 in 16. Large sums have from time to time been spent upon the engines, and, as they were wearing out it was resolved to adopt overhead traction. An arrangement was accordingly entered into with the Electric Construction Corporation to equip a large portion of the line for electric traction, to build a generating station, supply necessary plant, and maintain the system for a period of five years. The contract is at a certain fixed charge per car mile, but as a system of deferred payment has been adopted, it would be difficult to give figures which represented the actual cost per mile. The length of line on which electric power will be used is about 9 miles, which will be served by 16 cars. The working conductor is simply suspended on arms attached to specially made steel columns, about 21 feet above the footway. The length of arm carrying the conductor varies from two feet to five feet, according to the distance of the track and in case of stopping points. The arm of the column is stayed by a steel band which

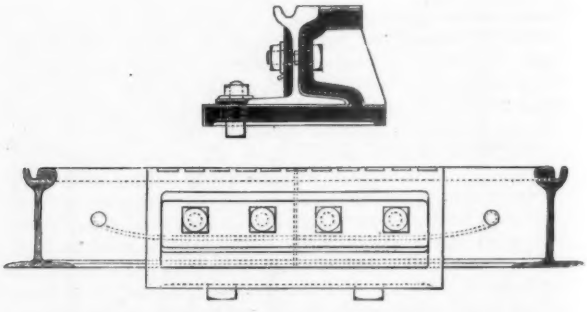
is clearly seen in our illustrations. No matter how sharp may be the curve, no stays or cross wires whatever are employed. Even at a most awkward junction, known locally as the Pleck, James Russell & Son, Wednesbury, designed some fine specimens, and these are now used throughout the system. They are calculated to bend something like 3 feet without injury. The trolley wire is of 0 gauge, hand drawn copper, divided into sections of approximately 880 yards in length. The feeders are insulated with vulcanised bitumen, lead sheathed, and armoured with a double layer of steel tape, the section being ·25 square inch and ·16 inch at the ends. They are carried underground from the station and are tapped at half-mile sections; fuses being inserted in the connections from the feeder to the trolley wire. Each half-mile section of working conductor can be completely separated from the feeders without interfering with the working on other parts of the line, so that a fault arising on any part of the conductor would be practically localised. The return circuit is completed through the rails, the fishplates being so bonded and jointed that the whole forms a path of low resistance. The following drawings show the section of the fishplate and elevation of the connected rails. All repairs are made from the top of a movable scaffold, which is mounted on a dray, an illustration of which is given. The columns bearing the conductor interfere little with the general aspect of the roads, and in cases where lamps are suspended they are a positive improvement on the old lamp posts. It must be remembered that the electric tram line runs not only through a country road but through the streets of Walsall, Wednesbury, and Darlaston. Their general unobstructive haracter may be gathered from our illustrations.

VIEW AT THE PLECK, SHOWING WEDNESBURY JUNCTION.

the whole arrangement depends on the frogs and the steel columns. It would be unfair not to award some meed of praise to the designers of these steel columns. Where so much depends upon them it is very necessary that they should be of the highest calibre. Trouble was at first experienced in obtaining what was required, but Mr. Johnstone, of Messrs.



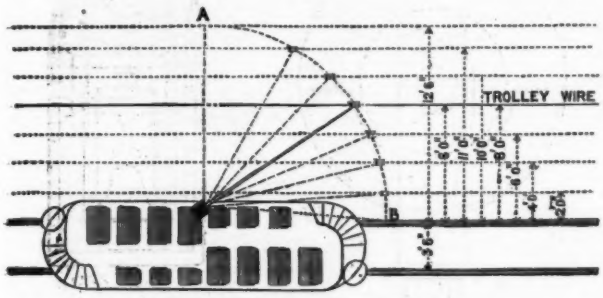
MOVABLE SCAFFOLD FOR LINE WORK.



SECTION OF FISHPLATE AND ELEVATION OF CONNECTED RAILS.

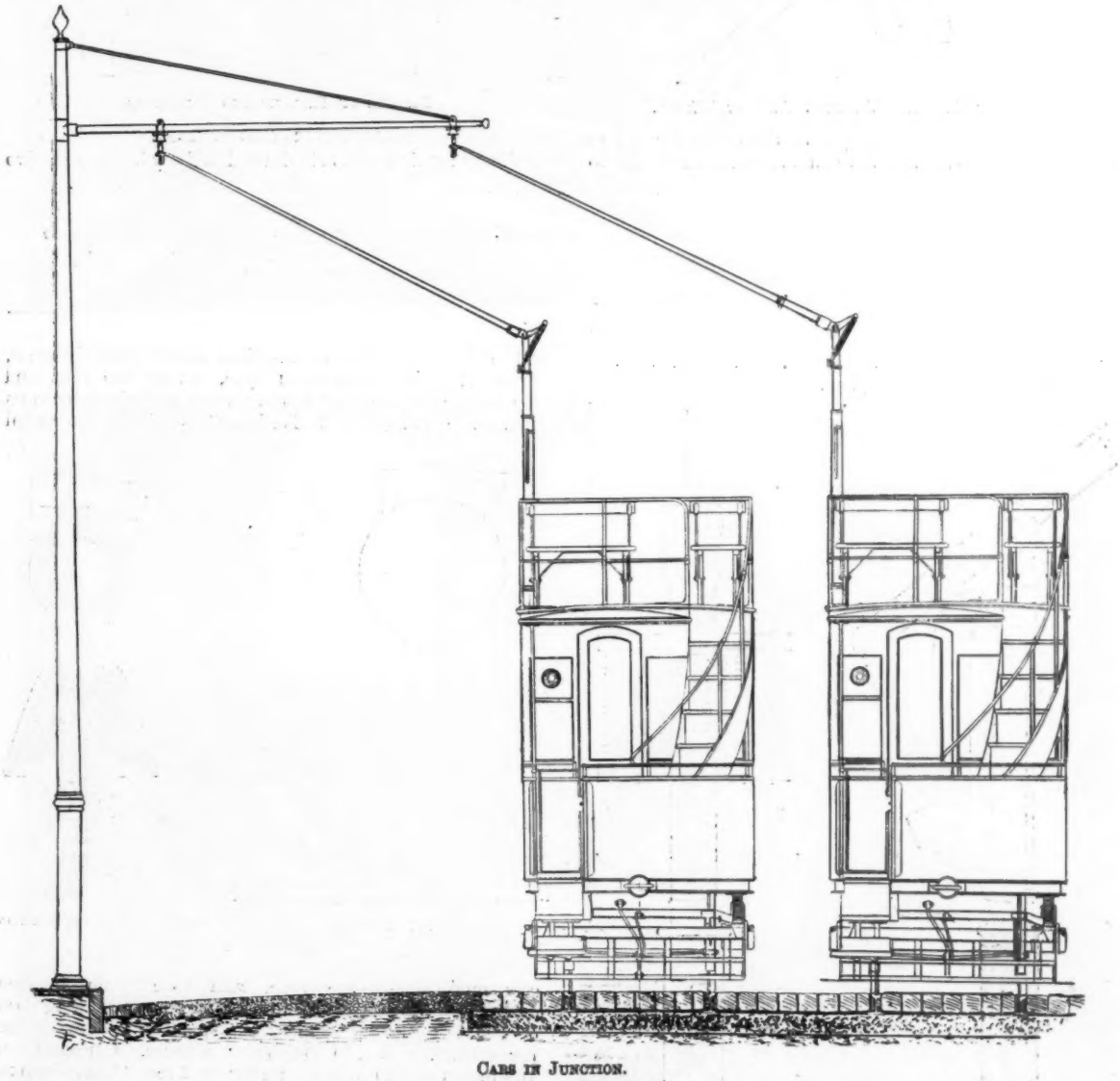
THE NEW SIDE COLLECTOR.

The whole system may be said to depend on the flexibility of the trolley mast or side collector. It is most agreeable to witness it take the sharpest curve and the most awkward switch, beautifully adjusting itself to all conditions of the road. The writer watched the collector in a few yards of road at one moment some 12 inches over the body of the car, and the next stretched out at right angles nearly 12 feet away. A diagram shows the range of the collector pole, A is the maximum distance the trolley wire can be from the car, but it may vary in distance from A to B. The collector automatically engages the trolley wire in any position between these points. How easily it works in the case of a stopping point may be gathered from the following diagram.



CAR ON LINE SHOWING RANGE OF MAST.

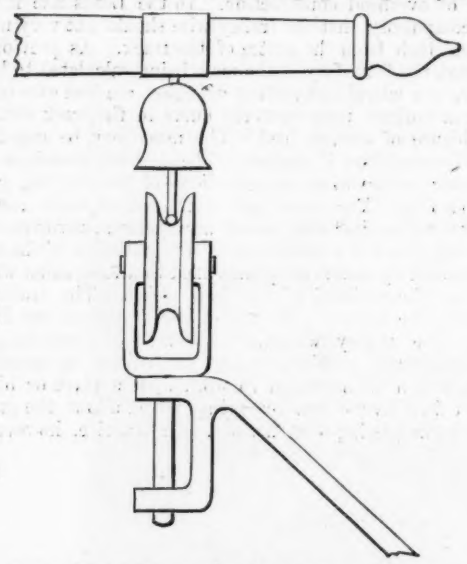
All that has been hitherto expected from a trolley was a play of some two or three feet, hence the costly and elaborate nature of overhead construction. In the Leeds line it was made compulsory that the trolley wire should not vary more than one inch from the centre of the track. As previously explained, the flexibility of the mast being calculated to keep the wire in a lateral and vertical direction, the feed wire could be run at a direct tangent to the curve in the track without a semblance of uneven feed. The mast may be raised or lowered several feet if desired. The detailed drawings will enable our readers to see the simplicity of the working parts of the trolley. The mast part of the trolley, made usually of metal with a ball and socket arrangement, revolves on a metal rod placed in a metal tube. The radiation of the mast is controlled by means of springs fixed to a loose collar which works on the pedestal of the ball socket. The trolley is hinged to the mast so as to give it lateral play in any direction. The trolley wheels, which are of gun-metal, 2½ diameter, can, if required, be kept in position by means of guides which are intended to work upon a pivot or hinge, and are kept in position by springs which allows the guides to open on passing obstructions. In practice, however, it has been found that these guides are unnecessary, and the trolley is used as shown in our illustrations.



CARS IN JUNCTION.

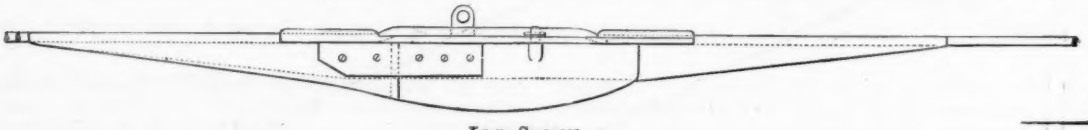
The line switches are among the often troublesome details, of overhead traction, but after many trials a form of switch has been adopted on the South Staffordshire

line which, on the occasion of the writer's visit, worked admirably. The switch at first designed was about 2 inches below the conductor, and the trolley on passing practically jumped the switch causing sparking. By means,



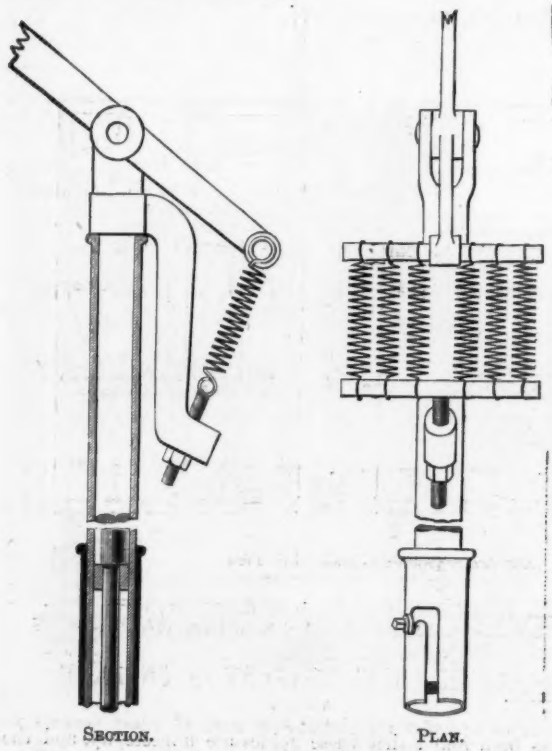
DETAILS OF TROLLEY.—SHOWING TROLLEY WHEEL.

however, of sweating sheet copper on the conductor and at each end of the switch, we have an arrangement similar to



LINE SWITCH.

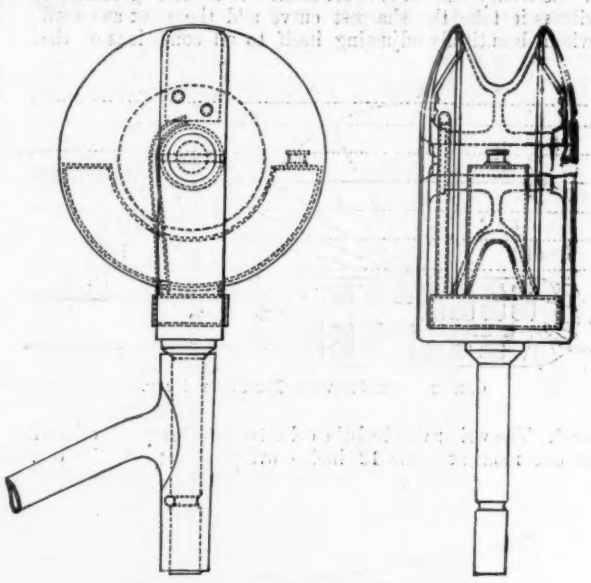
our drawing which makes an easy run. All the newer line switches will be made in one piece.



SECTION. PLAN.

DETAILS OF TROLLEY.—SPRINGS CONTROLLING TROLLEY.

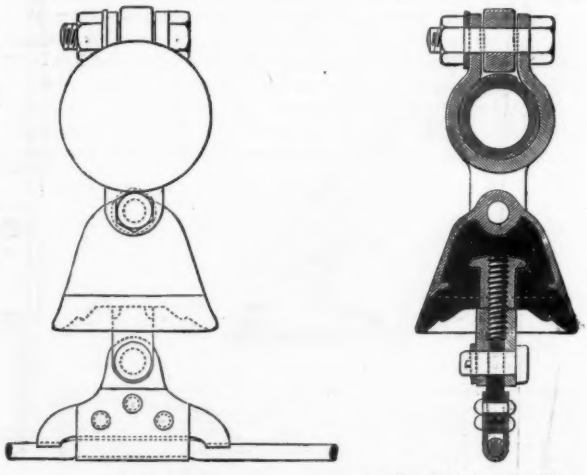
Detailed drawings will show the component parts of the insulator. It is practically a bronze insulator filled in with an insulating compound provided with mechanical clips. The screw which supports the conductor is firmly imbedded in the insulating material and forms altogether a sound piece of work.



DETAILS OF TROLLEY AND COLLECTOR.

THE GENERATING STATION.

The generating station is situated midway between the two ends of the lines. It contains three shunt-wound dynamos, of the Electric Construction type, giving 350 volts and 260 ampères at 450 revolutions. They are driven by ropes from three Musgrave & Sons' engines of the horizontal

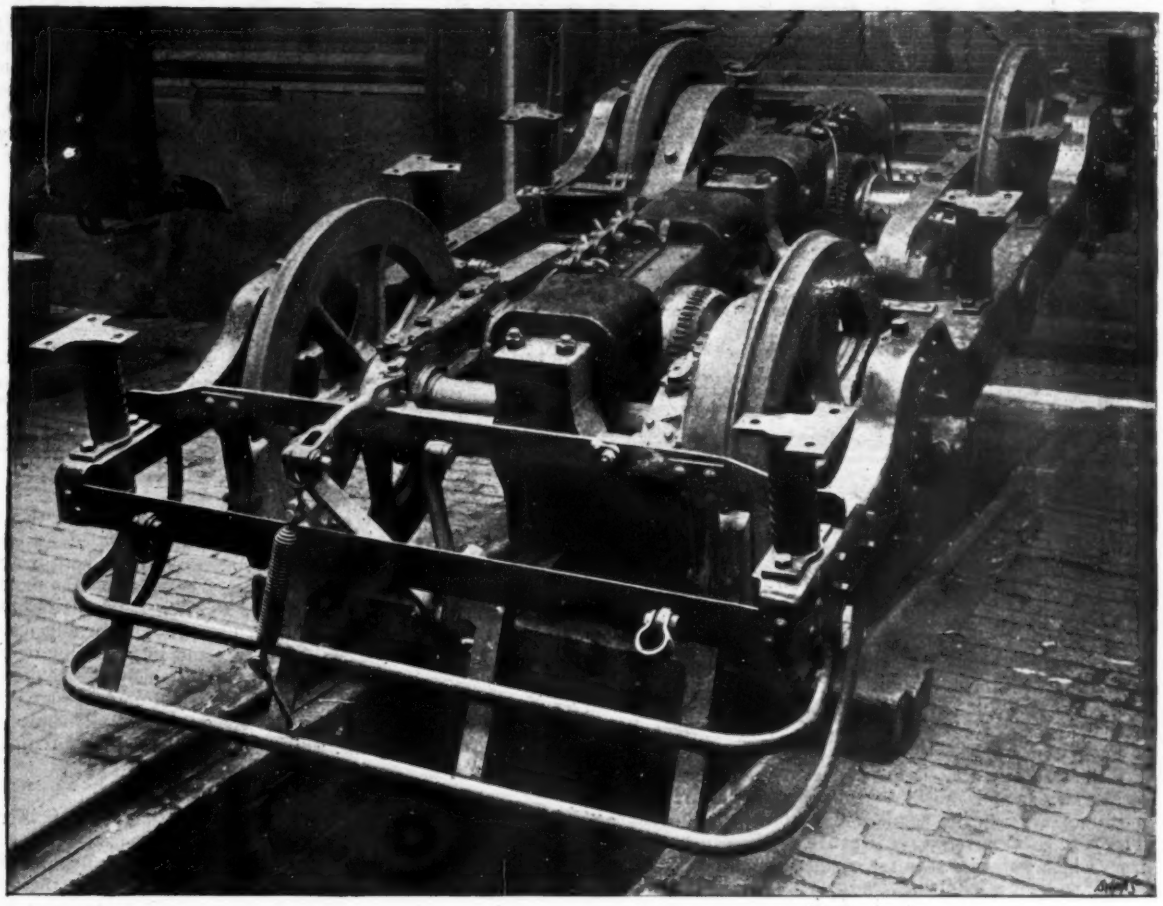


End elevation. Section of interior of insulator.

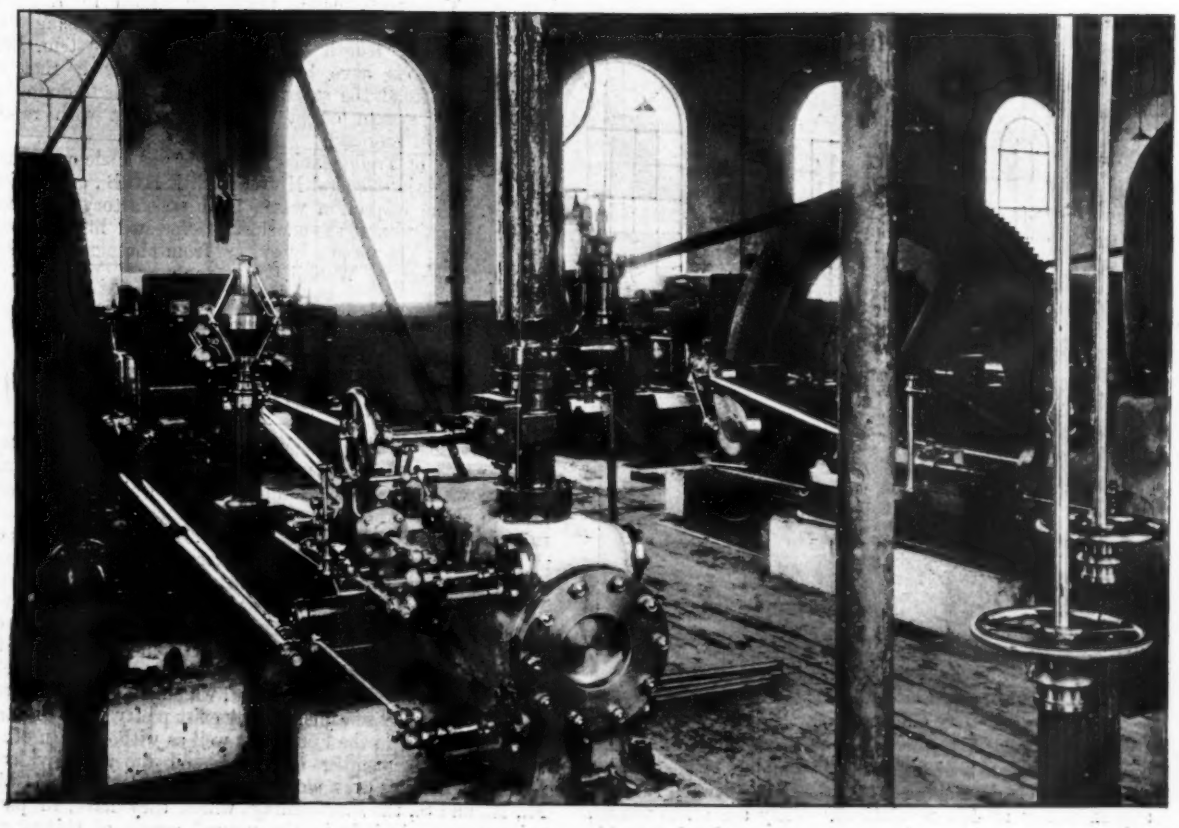
INSULATORS.

compound side-by-side type, with rope drum between cylinders, each capable of indicating a normal working load of 125 I.H.P. when running at a speed of 100 revolutions per minute, with 120 lbs. boiler pressure. Cylinders are 10½ inches and 20 inches diameter by 2 feet 6 inches stroke, and fitted with Corliss valves and Musgrave's patent automatic cut-off motion. The rope drums are 10 feet in diameter, grooved for nine ropes, 1¼ inch diameter. The air pumps are of the horizontal type with surface condensers.

Crank shafts are made of Siemens's steel, with bearings,

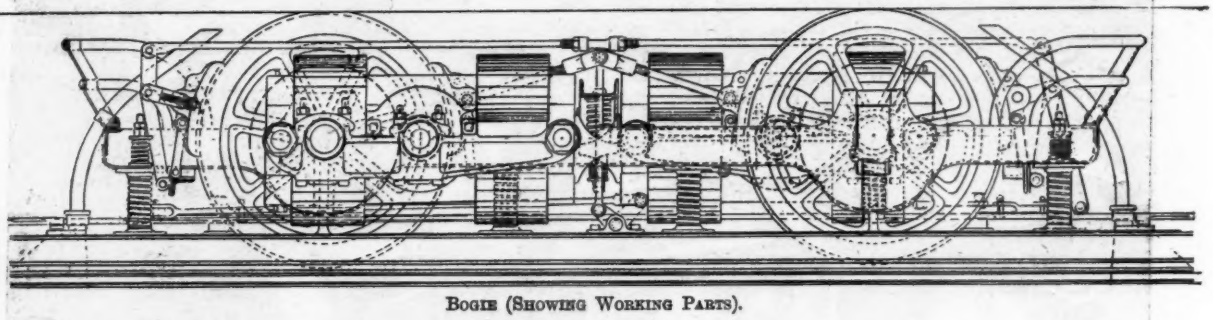


GENERAL VIEW OF BOGIE.



GENERAL VIEW OF GENERATING STATION.

6 inches diameter by 12 inches long, piston rods and crank pins are of the best mild steel, crossheads and connecting rods being made of forged iron. Governors are of the quick-speed type driven by ropes from the crank shaft. The crank shafts and crank pins are provided with self-lubricating oiling arrangements.



BOGIE (SHOWING WORKING PARTS).

There are three boilers, each 30 feet long by 7 feet diameter of the Lancashire type, made for a daily working pressure of 120 lbs. per square inch and tested by hydraulic pressure to 200 lbs. per square inch. The flues are 2 feet 9 inches diameter, with five conical tubes in each. The steam and feed pipes are arranged so as to give a duplicate service between the boilers, engines, and pumps.

Messrs. Musgrave & Sons have also supplied all the necessary pipes and valve connections for engines and boilers, also two donkey feed pumps for feeding the boilers.

Each dynamo has its own switchboard, on which is the E.C.C. automatic switch, ampèremeter, voltmeter and regulating switch and resistance coils for shunt circuit. The machines are run in parallel into common omnibus bars. The station is conveniently situated on the banks of a canal from which water is taken for condensing purposes.

THE CARS.

The cars, which have been specially built for the new service, are 22 feet long and will carry 40 passengers; they

CAR ON LINE.

are mounted on a bogie carrying two motors. The motors are capable of developing 15 brake horse-power, running approximately at 400 revolutions. They are series wound, the power being transmitted to the car axles by double helical cast steel wheels and pinions having a radius of 4 to 1. One motor is easily capable of taking a fully loaded car up the heaviest grade, on the line. They are fixed in dust proof casing, and are easily detachable from the bogie. There are two sets of brakes on each car, one being applied to the inside edge of the wheel, and the other on the outside. Each brake is worked separately. There are four dry sand boxes fitted on each car, two at each end. A complete set of switches is fitted at each end of the cars, and arranged so that either or both motors can be connected on the circuits. The speed of the motors is controlled by a multiple contact switch cutting resistance in or out of the motor circuit. The switching arrangements at each end of the car can only come into working on the interposition of a key, which is carried solely by the driver. Each car will be provided with a lightning arrester, and will be lighted by electricity. The car, when fully equipped, weighs about six tons, which is about ten tons less than the steam car.

CONCLUSION.

With this somewhat rough outline of the South Staffordshire Tramways Company's overhead system, we will conclude with complimenting the company generally, and Mr. Dickinson in particular, upon the manner in which the work has been designed. Nor should we omit to mention how well the work has been carried out by the Electric Construction Corporation under the personal supervision of Mr. Parker. The performance marks an epoch in English overhead traction. Not only is it important as being the first line of any length to use the overhead system, but previous methods have been so much modified, that if success does attend the scheme, and we see little to doubt it, the overhead system ought speedily to meet with rapid development in England.

The Board of Trade official inspection was made on Saturday last by Major-General Hutchinson, R.E.C.B., and Major Cardew. The inspection was a most satisfactory one, and Major Hutchinson at the conclusion expressed his approval of the work. The picture blocks are from photographs taken by Mr. Draycott, of Walsall.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE following letter reached us too late for our Correspondence pages, and it, curiously enough, bears out the contentions we make in our leading columns, which had already gone to press. The sarcastic vein in which it is written is fully justified, and will doubtless add zest to the appetites of those attending the Institution dinner :—

"If I take up my pen to comment upon the manifesto of Messrs. Erskine, Manville, Mavor, Raworth, and Swinton respecting the composition of the Council of the Institution of Electrical Engineers, it is not at all to formulate any reply to the indictment framed by these good men and true. I merely wish to complete their statement, which, it is well known, embodies partially sentiments that exist pretty widely in the Institution, within the Council as well as without. In other words, there are members of the Council who as individuals recognise, perhaps even more clearly than do Messrs. E., M., M., R., and S., the shortcomings which they have, in part, pointed out. As it is, in the natural course of things, my turn to retire from the Council in six weeks' time, I can

speak the more impersonally. The object dear at heart to the memorialists can, therefore, in one instance, be readily attained without friction.

"Let me first begin by classifying a little more definitely the membership of the Council (I take the official list, as the memorialists did; but, alas, we have just lost Mr. Graves!) As the term electrical engineer has no legal or recognised definition, and as every gas-fitter is, now-a-days, an electrician, I avoid these indescriptive terms. In passing, I remark how strange it is that the memorialists are able to discover no fewer than 10 professors who are neither 'electricians' nor 'electrical engineers.' Perhaps Prof. Hughes never was an electrician, in spite of his well-known inventions. Perhaps Prof. Hopkinson never was an electrical engineer; but, in that case—dreadful thought—who is? However, let that pass.

"The Council, including past presidents and vice-presidents consists, indeed, of the following:—

Manufacturers and contractors	5
Telegraph, telephone and cable men	13
Chemists	2
Engineers in consulting practice, not included in above	6
Baronets	1
Engineers to manufacturing firms	1
Government officials not included in above ...	2
Teachers of electricity not included in above ...	2
	32

"Or omitting past presidents and vice-presidents:—

Manufacturers and contractors	2
Telegraph, telephone and cable men...	5
Chemists	0
Engineers in consulting practice, not included in above	5
Baronets	0
Engineers to manufacturing firms	1
Government officials not included in above ...	2
Teachers of electricity not included in the above ...	0
	15

"Inspection of these figures at once shows on what head the Council is overweighted. But, then, the Institution must be forgiven for the circumstance that it originated as a body of telegraph engineers, and not as a body of manufacturers or contractors.

"But really there is a grain of reason in the contention that there are in the Institution and on its Council gentlemen 'only indirectly connected with practical engineering.' Too often the phrase 'practical engineer' is held to denote one who has served seven years of drudgery at the bench. Well, but that is precisely (—my friends will pardon me for so personally using them as examples—) what my friend John Perry, engineer and professor did, it is precisely what my friend William M. Mordey, engineer and inventor, did not do. It is within the bounds of possibility that there may be contractors and manufacturers who are even less directly connected with practical engineering.

"It is a pity for the memorialists' case that they have so sadly understated the "professorial element" on the Council. Their delicately-concealed suggestion that if a man has at some time or other held a responsible post as a teacher, that circumstance in some way disqualifies him to take part in managing a "professional" body such as the Institution, reaches more widely than to the 10 "professors" (including Lord Kelvin) so denominated in the official list of the Council. To these 10 should be added Prof. Sir Frederick Abel, Prof. John Hopkinson, Prof. (now General) Webber, and Prof. Crookes, not to add Mr. Mordey and Mr. Swinburne, both of whom have qualified themselves for the same courtesy by systematic teaching. So the 10 should be written 16. It is evidently high time that the number of 'Professors' on the Council should be reduced. There is also an undue proportion of members of Council whose names begin with the letter C. Moreover, compared with the Civil Engineers, there is a smaller proportion of 'Sirs' on the Council. This is a sad oversight, which might be commended to the notice of the P.M.G. (I do not mean the *Pall Mall Gazette*).

"What seems to be the saddest fault of all is the complete absence from the Council of any person who, being neither an engineer in consulting practice, a teacher, a soldier, a sailor, an officer in the volunteers, a government official, a company director, a company promoter, a cable man, a telegraph operator, a chemist, an author, a peer, or a baronet, and never having been any one of these things, shall be therefore competent to represent 'those actively engaged in constructive work.' The omission is not, however, irremediable. Doubtless the Council, awakened at last to a sense of its short-comings, will fill one of the shortly-vacant places by the member entitled to such unique distinction—if he can be found.

"SILVANUS P. THOMPSON."

THE NEW YORK—CHICAGO TELEPHONE LINE.

THE opening of this line, which took place on October 18th, may be regarded as the successful result of a bold experiment. The actual length of the line is stated to be 950 miles. The wires, of which there are two erected on the twist principle, weigh 435 lbs. to the mile and are erected on 35 feet poles, there being 45 poles to the mile. Taking the resistance per mile to be 2·1 ohms, and the capacity ·0156 microfarad, this makes the K R of the line to be

$$\cdot0156 \times 950 \times 2\cdot1 \times 950 = 29{,}500 \text{ approximately.}$$

The result, therefore, once more proves the incorrectness (at least, as regards a metallic loop with the wires running in close proximity to each other), of the supposed limit of practicable speech, which, on an aerial line, has been set down at 10,000. The latter value is doubtless correct in cases where K and R are the only limiting elements, indeed, experiments on artificial lines prove this, but in actual looped telegraph lines other elements, such as mutual induction between the wires, step in and materially modify the simple K R law.

The cost of the new line, says the New York *Electrical Review*, has been something enormous. The wire alone, at 15 cents a lb., for 826,500 lbs., would cost $123,975; to this we must add the cost of 42,750 cedar and chestnut poles, wages and service, which would make the cost of the entire circuit amount to about $380,000, roughly estimated. This line must be kept in constant repair, and the running expenses are not to be overlooked, so that the cost of five minutes' conversation, which has been fixed at $9, must not be regarded as excessive, for it must be remembered that while the person is conversing he practically has the loan of $380,000 for five minutes and that an answer may be obtained immediately to each question.

With reference to the K R question, the following from the *Electrical Review* seems to indicate that our American friends have even yet not grasped the fact that the K R of a metallic loop is the same as that of a single wire worked with earth at the ends, and not that of the whole loop treated as if it were a single wire of the length of the loop. "The conductor is a No. 8 B. W. G. copper wire, about 97 per cent. purity, weighing 435 lbs. to the mile, supported on 30-foot poles. Its resistance is 2·1 ohms to the mile, or about 4,000 ohms for the line. The capacity at ·0156 microfarad per mile would be for the line 29·64, making K R (capacity multiplied by resistance) 118,560, many times a multiple of the calculated limit (10,000) already referred to." In other words the true K R has been multiplied by 4.

Dundalk Electric Lighting.—A special meeting of the Dundalk Town Commissioners was held last Thursday, to consider the reply of the Board of Trade to the Commissioners' application for a renewal of the electric lighting license which expires on July 1st next. The gas company's contract expires in June next. Mr. Moynagh, the Board's solicitor, who had been in communication with the Board of Works, recommended the Commissioners to go for a provisional order and at the same time memorialise for a renewal of the license. Further action was adjourned until April next.

NOTES.

Institution of Electrical Engineers.—Last evening the discussion on Mr. Swinburne's paper on "Problems of Commercial Electrolysis" was continued.

A students' meeting will be held at 28, Victoria Street, on Friday, 25th inst., when Mr. Howard Little will read a paper on "The Telephone."

Provisional Orders.—The *London Gazette* contains announcements regarding applications which are to be made to the Board of Trade during the 1893 session for provisional orders for the production, storage, and supply of electricity, and the usual incidental powers, by the public authorities of Islington, Hackney, Eccles, and Newcastle-on-Tyne.

The Electric Light Question at Taunton.—A special meeting of the Taunton Town Council was held on Friday last, for the consideration of a resolution to the effect that application should be made to the Board of Trade for a provisional order to supply electricity for public and private purposes within the borough, and also within the rural sanitary district of the Union; that the Town Clerk should be authorised to take the necessary steps for carrying the resolution into effect. After a deal of discussion, the resolution was carried with only one dissentient.

Mr. W. H. Fowler, chairman of the electric lighting company in that town, has been elected Mayor of Taunton.

Plymouth Tramways and Electricity.—Mr. J. C. Robinson, the expert engaged by the Plymouth Corporation to consider the extension of the tramways at Plymouth, refers in his remarks rather lengthily to the advantages to be gained by adopting electric traction. He recommends the overhead wire or trolley system, as at Leeds. Entering into the matter of cost, he considers that a substantial building, amply sufficient for car depôt, workshops and offices, would cost about £5,000. The power plant would consist of two 250 H.P. engines with suitable boilers, and two dynamos of from 200 to 225 H.P. The steam power he estimates would cost about £12 per H.P., or £6,000, and the electric plant about £3,600. The carrying out of the scheme would require the provision of ten electric motor cars at a cost of £600 each. The total cost of the electric equipment he considers, including plant, machinery, buildings, cars, &c., would be £25,000. Mr. Robinson thinks the annual cost of working the electric system would be £7,800, and calculates that the returns would equal 7½ per cent. of a capital outlay of £50,000.

Accidents.—What might have had as tragic an ending as the previous accident, occurred in connection with the overhead wiring in Melbourne a short time ago. Some repairs were being effected to the telephone wire in Russell Street, near Little Collins Street. One wire had been cut and was trailing on the ground; it caught in the dress of one of two young ladies who were passing at the time. She grasped it with one hand, which fortunately was gloved, intending to release it from her dress, and received a shock which threw her to the ground. A young man grasped her round the waist and started to drag her from the wire which was still attached to her, but he managed to step on it or come in contact with it in some way, and was also thrown to the ground by the shock. A second man was about to come to the rescue, when the line repairer, noticing the danger, lifted the loose wire off the lighting circuit and thereby stopped the current. Neither of the persons were injured beyond receiving the shock.

Another curious accident of a different nature, but in which a telephone circuit was also more or less responsible, occurred a short time ago during the recent equinoctial storms at Granville, near Sydney, New South Wales. Mr. Fernside, relieving station master there, was at the telephone in the office, when, as the papers described it, the instrument gave off a lightning stroke which threw Mr. Fernside down insensible, his face becoming quite black. He was taken home at once and attended to, but has not yet recovered from its effects.

Wolverhampton Electric Lighting.—At the meeting of the Wolverhampton Town Council last week, the following resolution was agreed to:—"That in the event of the Gas Company applying to Parliament for authority to raise additional capital or for further powers in regard to their gas undertaking, the Lighting Committee and the Town Clerk be authorised to take such steps in regard thereto as may be necessary or advisable to protect the interests of this corporation as gas consumers and purveyors of electricity, and to cause the official seal to be affixed where required, and the committee be empowered to renew negotiations."

Huddersfield Electric Lighting.—The electric lighting operations at Huddersfield are now rapidly progressing. The laying of mains is nearly completed, there being 2,900 yards of conduit laid for the high tension mains, 3,550 yards of conduit for the low tension mains, and 64 junction boxes have been built. A number of tradespeople have already applied for connection to the mains. There have been several drawbacks to pushing forward the work; first, the delay in obtaining the sanction of the Local Government Board for borrowing the money; and, later, the masons' strike. Had it not been for these unavoidable delays, the light would have been supplied during the present winter; it, is, however, expected to be quite ready by the spring of 1893.

City and Guilds of London Institute.—The report for 1892 of the Examinations Department of this Institute, which has just been issued, states that at the recent examinations the total number of worked papers, omitting those from the candidates for the manual training certificate, was 8,534, as against 7,416 in 1891, showing an increase of 1,118, the largest increase in any previous year since 1884. The percentage of failures is somewhat higher than in 1891, having increased from 44·7 to 47·6. This is mainly due to the less satisfactory results in cloth weaving and in electric lighting, in which latter subject a new syllabus had been issued. Owing to the higher percentage of failures, the increase of passes is only 370 as compared with 592 in the previous year. The largest increase in candidates has been in the Mechanical Engineering Division, the number having risen from 739 to 966. In previous reports notice had been taken of the gradual falling off in the number of candidates in this subject, from 1,122 in 1888 to 739 in 1891; but the numbers for this year are nearly on a level with those of 1890, when 972 candidates presented themselves. Some improvement is shown in the work of candidates in telegraphy, but in the subject of electric lighting, in which the number of candidates has increased from 392 to 447, the results of the examination are far less satisfactory. The development of the work connected with the examinations is shown not only by the increase in the numbers of students and candidates, but also by the wider area covered by the Institution's operations. The number of towns in which the Institute has centres has increased from 162 in 1890 to 193 in 1891, and to 210 in 1892; whilst the numbers of technical classes for the three years are 483, 519 and 610. Of the centres outside London, Manchester has sent up the largest number of successful candidates, the number being 301, which is, however, 10 less than the number given in the previous report. Next in order are Glasgow with 213 as against 247; Dundee with 155 as against 128; Leeds with 125 as against 89; Preston with 108 as against 88; Edinburgh with 90 as against 85; Huddersfield and Rochdale with 83 each, as against 106 and 77 respectively; Aberdeen with 66 as against 72; Bristol with 63 as against 92; and Bradford with 61 as against 78. In London the number of students in the Institute's registered classes, excluding those at the Technical College, Finsbury, was less in 1891 than in 1890, the numbers being 1,407 and 1,562; but this year there has been a great accession of students, the number having risen to 1,998. This year 931 candidates came up for examination, as against 886 in 1891, and 595 satisfied the examiners as against 565 in the previous year. It will be seen that the proportion of candidates to the population is far less in London than in Manchester and in other cities, and it may be expected that the larger facilities for technical instruction, which will be available within the next few years, will lead to a marked increase in the number of students and of candidates for examination.

Chesterfield and Electric Light.—At a special meeting of the Chesterfield Town Council last week, it was resolved that application be made to the Board of Trade for a provisional order, so that, whether they went in for supplying the town with electricity or not, they would be in a position to avert any monopoly, and to make terms with any company which might approach them on the subject.

Electric Lighting in India.—A private installation on a very large scale is being erected in the residence of the Prime Minister to the Prince of Nepaul. The cost of the work, says *La Lumière Electrique*, is not less than 250,000 francs. There are 250 16-C.P. incandescent lamps, and 10 300-C.P.; also a projector of 40,000 C.P., the latter being for the purpose of lighting a near valley.

Found Drowned.—The site chosen for the York central station is Foss Island. Foss Island seems to object, for when last heard of, it was skulking under water. When the waters abate, and the fortunate contractor is able to alight on it, perhaps he will revert to the ways of pre-historic man, and build on piles.

Traction.—A new company has just been formed at Pari. for all operations relating to electric traction in France. This company starts with a capital of 350,000 francs, for a period of 25 years.

Merchant Venturer's School at Bristol.—The medals and prizes won by students in the mechanical and electrical engineering departments of the Merchant Venturer's School, at Bristol, will be distributed on December 8th by Sir John Fowler, Bart., K.C.M.G. There has been a large increase in the number of students during the year.

Dover and the Electric Light.—At the request of the solicitors to the Brush Electrical Company, a small committee of the Dover Town Council has been appointed for the purpose of considering the several items of the conditions for supplying the borough with the electric light.

The City Electric Lighting.—At a meeting of the Commissioners of Sewers, the Streets Committee submitted a letter from the City of London Electric Lighting Company relative to the progress made in supplying private consumers, and it was agreed that the company be urged to expedite the matter as much as possible. The consideration of an application from the same company with respect to sites for converter stations was adjourned.

Death Caused by an Electric Shock.—A sad fatal accident happened last week to an employé of the House-to-House Electric Light Company, named Thomas Lang, who was working at one of the company's mains in the Old Brompton Road. We understand that the unfortunate man grasped the cable in his right hand, receiving a shock from a current under pressure of 2,000 volts; the hand was terribly charred. At the inquest, it was stated that had the insulation on the cable been perfect the shock could not have been received. A fellow workman said that he had to sever the cable with an axe before he could take it from the deceased man's hand, and immediately it was severed he fell to the ground on his head. The jury returned a verdict of "accidental death," but said that no blame attached to the company.

Destruction of Overhead Wires by Fire.—An extensive fire occurred in Liverpool on Friday last week, and the flames burned through the roof of a warehouse, entirely destroying the network of telephone and telegraph wires which crossed the street above the building. They fell into the street in numbers, making a hissing noise, and scaring the usual crowd of spectators. The following morning a company of men were set on the repairing work, and it was found that fully 50 telephone wires, and an equally large number of telegraph wires, had been burned. Much inconvenience was caused by the stoppage of communication, especially as no less than six of the telephone lines broken down were fire police wires, the destruction of which delayed the despatch of firemen to another small fire in the neighbourhood.

The Electro-Harmonic Society.—For the Ladies' Night, the musical directors have engaged the Queen Vocal Quartette (Miss Mina Rees, Miss Mary Hutton, Miss Amy Sargent, and Miss Lucie Johnstone), Mr. Clement Hann, a younger brother of Mr. W. C. Hann, an established favourite at these meetings, who will emulate the latter's performances on the violoncello, and Mr. Frederick Upton, of "Sensation Novel" fame, as the humourist. Mr. Izard, as usual, will preside at the piano as soloist and accompanist, and the programme generally is an attractive one.

Newbury Lighting.—After spending £300 recently for an electric light provisional order, the Newbury Town Council, on Wednesday last, decided to apply for powers enabling them to borrow £10,000, to be expended on the gas undertaking of the town.

Telephony in France.—It appears that the service of the Grand Hotel des Telephones de Paris has come to an end. The installation of multiple telephonic apparatus has been begun, which are in future to be used for all communications. It is hoped that the service will commence January 1st, 1893.

Barnard Castle Electric Lighting.—A representative of an electric company at Barnard Castle, joined by several members of the Local Board, made an inspection last week with a view to preparing an estimate for lighting the town of Barnard Castle with electricity. In the event of the adoption of electricity for the town, the County School will also be lighted thereby.

Elmore.—We reproduce the following letter from the *Financial News* of Wednesday last, and leave it to speak of itself:—

THE ELMORE COPPER COMPANIES.

After the decision in the case of Russell *v.* Mockford on Saturday, I am resolved to take action against the directors of two of the Elmore companies, and shall be glad to know the views of others who have been victimised, if they will communicate with me at the address below.

T. SATCHWELL.

20, Bucklersbury, E.C., *November 14th*.

Commercial Electrolysis.—A correspondent writes:—"Mr. Cooper speaks of his Hermite's process; Mr. Cross of the results obtained by the Hermite method; Mr. D. Fitz-Gerald dilates upon his lithanode; Mr. Faulkner on *his* lithanode, but does not say how many cwts. of fibre he has bleached during the last three years. This is what they call a discussion on 'Commercial Electrolysis.'"

Dr. Hopkinson's Case.—Yesterday (17th inst.) Mr. Hopkinson, Q.C., applied to Mr. Justice Romer, in the Chancery Division of the High Court of Justice, for an order giving leave to issue subpœnas in Scotland requiring the attendance at the trial of a number of witnesses whose presence was absolutely necessary. The learned counsel said that he had an affidavit giving the names of the desired witnesses, and his Lordship would see that an entirely new issue having been raised, this application was imperative. Mr. Justice North had already dealt with certain witnesses in the manner his Lordship was asked to do with these fresh witnesses. Mr. Justice Romer granted the application.

An Interesting Interview.—A shareholder in one or more of the Elmore companies called at the REVIEW office yesterday, and afforded us quite a pleasant interview. After asking us whether we had any reason for publishing such "severe reports" and criticisms regarding those companies, which question we answered by referring him to various articles we had written, this individual accused us of damaging good and sound public property, by making the share quotations fall on the Stock Exchange, and asserted that we criticised, *not* in the public interest at all, but for some other reason, which it appears he seems to know better than we do ourselves. Before leaving us, he said he hoped we should "run them down" still more, so as to get an even lower quotation, and thus enable him to buy up some more shares still more cheaply. Then, with a snort of defiance, he took a hurried departure, and we knew him no more.

Fire.—Early on Wednesday morning a fire occurred at the premises of the London Stereoscopic and Photographic Company, Limited, at Nos. 106 and 108, Regent Street. In his official report, Captain Simonds states that the cause of the fire was "overheating of electric wires," which had set fire to the shop window and its contents.

Tramway Extension in the Blackpool District.—The Blackpool Corporation have decided to extend the electric tramway. It is intended to carry the line round Whitegate Lane, Marton, and from thence along Cow Gap Lane to the South Shore, where it will join the existing line. A new company is in process of formation, to construct a similar system of tramways between South Shore, St. Annes, and Lytham.

Ship Lighting.—Mr. F. Young writes :—"Can any of your readers assist me in the following difficulty with small switches for ships' incandescent lamps? In this particular case a number of lamps light up a deck, each having a separate 'tumbler' switch placed close to the lamp, and screwed to woodwork. The wood always contains briny moisture from spray and washing down; this moisture gets to the wire at the weak point just where it enters the switch, and leakage and corrosion of wire takes place. Is there any switch that gives additional protection to the wire by small leading-in tubes of insulating material at the back?"

The Late Mr. E. Graves.—The following is a list of the gentlemen present at Mr. E. Grave's funeral :—Prof. W. E. Ayrton, F.R.S. (president), Mr. Alexander Siemens, General C. E. Webber (late) R.E., Mr. F. H. Webb (secretary), representing the Institution of Electrical Engineers; Messrs. G. W. Casserley, T. Fletcher, F. Rudall, G. E. Preece, W. Brough, W. W. Turner, W. H. Winter, C. E. Winter, J. C. Lamb, C.M.G., J. Ardron, A. E. Chambre, C. F. Cartwright, H. L. Kingsford, P. J. Burrell, P. Benton, A. Pamphilon, J. Laister, A. C. Woodward, J. R. Burr, E. Winter, H. C. Fischer, J. T. Hill, W. H. Preece, F.R.S., J. Hookey, H. C. Hart, J. B. Chapman, J. H. Cordeaux, H. R. Kempe, H. J. Vose, T. H. Stockwell, A. Eden, A. J. Stubbs, T. Reid, J. G. Dalladay, G. H. Comport, jun., I. Probert, W. Brown, T. E. P. Stretche, J. Smith, C. E. Grove, H. Eaton, C. F. Fleetwood, J. C. Chambers, F. E. Evans, J. Gibson, W. Louth, J. Gavey, E. Ashton, J. Doherty, A. W. Heaviside, H. Pomeroy, J. Jenkin, D. Lumsden, W. R. Culley, H. Marsh, F. Pollard, J. E. Thompson, J. Wrake, Colonel Armstrong, R.E., Major G. W. Addison, R.E., Captain A. E. Wrottesley, R.E., Lieutenant G. Morrison, R.E., Messrs. E. E. Stuart, J. Bolton, H. Jeff, M. F. Roberts, T. Britton, A. Langman, E. Catley, J. W. Turner, F. S. Parkinson, &c.

NEW COMPANIES REGISTERED.

New British Electric Installation Contractors, Limited.—Capital £25,000 divided into 5,000 shares of £5 each, to acquire, carry on, develop and extend, the business heretofore carried on at Worcester by the British Electrical Installation Contractors, Limited, and to enter into the agreement mentioned in the 4th clause of the articles of association; to carry on the business of electricians, electrical and mechanical engineers and contractors, and to undertake the lighting of streets and other places, public or otherwise, and to produce and supply electricity generally. The subscribers (with one share each) are : S. T. Castle, Worcester; A. H. Parker, Worcester; J. S. Cook, Worcester; R. Jurmar, Worcester; A. Usher, Worcester; W. H. Walker, Worcester; J. Duce, Worcester. The number of directors is not to be less than three nor more than five, the first being appointed by the subscribers to the memorandum of association. Qualification £5. Remuneration £250 per annum. Registered on the 29th ultimo by Richard Jordan, 120, Chancery Lane, W.C.

Dominion Electrical Company, Limited.—Capital, £25,125, divided into 5,000 ordinary shares of £5 each, and 500 founders' shares of 5s. each; to carry on the business of a telegraph, telephone, and electric light, heat, and power supply company, and, in particular, to acquire, establish, work, manage, control and regulate works and conveniences for the supply of electric light, heat, and motive power, and to transmit, and facilitate the transmission of, telephonic and telegraphic communications and messages; and to undertake the lighting of towns, streets, buildings, and other places, and the supply of electric and motive power for public and private purposes. The subscribers (with 1 share each) are: T. A. Kerr, Upper Norwood; W. R. Morton, Gipsy Hill; J. F. Lea, Fox Hill, S.E.; G. A. Kerr, Upper Norwood; E. A. Horne, Leytonstone; H. T. Sayle, Brixton; W. B. Campbell, Upper Norwood. Until otherwise determined, the number of directors is not to be less than five. Qualification, 50 ordinary or 10 founders' shares; remuneration, £1,000, to be divided. Registered on the 29th ult. by F. A. Rehder, 14, Mincing Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New Telephone Company, Limited.—The annual return of this company, made up to January 14th, has been filed. The nominal capital is £120,000, in £5 shares; 3,000 shares have been taken up, and £5 has been called on each of 2,000 shares. The calls paid amount to £9,960, and unpaid to £40. Registered office, 90, Cannon Street, E.C.

D. Hulett & Co., Limited.—The annual return of this company, made up to September 12th, 1892, shows that out of the nominal capital of £35,000, that 5,900 £5 ordinary shares and 100 founder's shares of £5 each have been taken up. The total amount of calls received is £9,500, and that agreed to be considered as paid on 4,100 shares is £20,500. Filed by Jordan & Son, September 12th, 1892.

Telegraph Manufacturing Company, Limited.—The annual return of this company, made up to July 29th last, shows that out of the nominal capital of £50,000, 2,800 shares of £10 each have been taken up; and that there has been £10 called up on each of 2,154 shares. The total amount of calls received is £21,540, and £6,460 on 646 shares has been considered as paid. Filed July 29th, 1892.

Electric Trust, Limited.—The annual return of this company, made up to the 10th inst., shows that out of the nominal capital of £60,200, 1,675 £10 shares and 167 £1 shares have been taken up. There has been £10 called on each of the ordinary shares, and £1 on the founders' shares, and the total amount of calls received is £16,917.

Abell's Electrical Engineering.—The statutory return of this company, filed on September 17th, shows that out of the nominal capital of £5,000 divided into 1,000 shares of £5 each, 360 shares have been taken up. There has been called on each of 240 shares the sum of £3, and the total amount of calls received, including payments on application and allotment, is £650, with £600 agreed to be considered as paid on 120 shares, and £70 which still remains unpaid.

Crompton & Company, Limited.—A notice has just been filed at Somerset House to the effect that the capital of this company has been increased to £300,000 by the issue of 22,000 ordinary shares of £5 each, such shares to be numbered 8,001 to 30,000, inclusive, and to rank as regards dividends, and in all other respects *pari passu* with the already existing ordinary shares of the company.

Electric Arms and Ammunition Syndicate, Limited.—The annual return of this company, filed on September 13th last, shows that out of a nominal capital of £40,000 divided into 400 shares of £100 each, 290 shares have been taken up. There has been called up on each of £80 shares £70, and the total amount of calls received, including payments on application and allotment, reaches a sum of £5,540. There is £60 standing as the total of calls unpaid. Filed by Jordan & Sons, 120, Chancery Lane, W.C.

Durand Electric Petroleum, &c., Company, Limited.—A letter has been filed at Somerset House by a Mr. F. E. Wright, stating that this company has never allotted any shares, had any shares subscribed for, or traded in any way.

London Metallurgical Company, Limited. — The statutory return of this company, made up to April 27th, 1891, shows that out of a capital of £15,000 in 1,500 shares of £10 each, 384 shares have been taken up. There has been a sum of £5 called up on each share, and the total amount of calls received has reached £1,887. An item of £33 stands as the total amount of calls unpaid. The name of the secretary is Mr. Charles Streete. A notice was filed on August 31st, 1891, to the effect that the capital had been increased by the addition thereto of the sum of £5,000 in 500 £10 shares beyond the registered capital of £15,000.

Babcock & Wilcox, Limited.—The annual return of this company, filed on October 6th, shows that, out of a nominal capital of £240,000 divided into 10,000 preference and 14,000 ordinary shares of £10 each, all have been taken up, 7,999 having been issued as fully paid. The total amounts called have been paid on the remainder of the shares.

Ernest Scott & Mountain, Limited.—The annual return of this company, filed on the 20th ult., shows that, out of a nominal capital of £70,000 divided into £10 shares, 4,653 have been taken up, of which 2,220 have been issued as fully paid. There has been £6 5s. called on 1,981 shares, and the full amount upon 472 shares, making *in toto* a payment of £17,099 10s., £1 15s. being in arrears.

Grange Syndicate, Limited.—The High Court of Justice, according to a notice filed on April 2nd last, ordered that the above company be wound up under the provisions of the Companies' Acts, 1862 to 1890.

J. C. Howell, Limited.—The statutory return of this company, made up to the 1st inst., shows that out of a nominal capital of £25,000, divided into 5,000 shares of £5 each, 2,907 shares have been taken up. There has been £5 called on each of 907 shares, and £5 has been agreed to be considered as called on 2,000. The total amount of calls received, including payments on application and allotment, reaches £4,510. The amount considered as paid on 2,000 shares is £10,000, and the number of calls unpaid is equal to the sum of £25.

Ipswich Electricity Supply Company, Limited.—The annual return of this company, made up to the 19th ult., shows a nominal capital of £100, divided into £1 shares. The business between the British Electrical Engineering Company, Limited, and Messrs. Laurence, Scott & Co., Limited, respecting the transfer of the Ipswich works of the latter company to the Ipswich Electricity Supply Company, Limited, is still incomplete, owing to seven shares only having been taken up, and no calls made.

Mather & Platt, Limited.—The statutory return of this company, made up to September 7th, shows that out of a nominal capital of £200,000 divided into £10 shares the shares issued, with £9 paid, are the only ones taken up.,

International Electric Subway Company, Limited.—The registered offices of this company have been changed from 43, Threadneedle Street, E.C., to Albany Buildings, 39, Victoria Street, Westminster, S.W.

Lineff Electric Traction and Lighting Syndicate, Limited.—The annual return of this company, made up to October 5th last, shows that out of a nominal capital of £10,000, divided into 10,000 shares of £1 each, 9,131 shares have been taken up. There has been £1 called up on each of 1,128 shares, and the total amount of calls received, including payments on application and allotment, reaches £1,128. The maximum sum agreed to be considered as paid on 8,003 shares is £8,003.

The Railway Electrical Fog Signal Syndicate, Limited.—The registered office of this company is situated at St. Peter's Church Walk, in the town of Nottingham.

The London Electric Manufacturing Company, Limited.—The registered office of this company is situated at 50, Old Broad Street, E.C.

Railway Electric Reading Lamp Company, Limited.—The registered office of this company is situated at 1, Great Winchester Street, Old Broad Street, E.C.

Lithanode and General Electric Company, Limited.—The registered office of this company is situated at 11, Abchurch Lane, London, E.C.

Edison Phonographic Toy and Automatic Company, Limited.—A notice has been filed at Somerset House, by A. R. Ramsay, to the effect that the situation of the registered office has been changed to 2, Metal Exchange Buildings, E.C.

British Electric Propulsion and Traction Company, Limited.—Notice of change of situation of this company's registered office has been filed at Somerset House. The office is now at Victor Works, Victor Road, Holloway, N.

Central Electrical Company, Limited.—A notice has been filed at Somerset House by Gordon Saies, to the effect that the registered office of this company has been changed to 15, Union Court, Castle Street, Liverpool.

Akester Electro-Motor and Accumulator Company, Limited.—Notice of change in the situation of the registered office of this company has been filed at Somerset House. The office now is at 6, Ropemaker Street, Finsbury Pavement, E.C.

ELECTRIC LIGHTING AT THE GUILDHALL.

PERHAPS the most interesting, as well as the most successful, piece of electric lighting work in the City at the present time is the illumination of the Guildhall. An especially notable fact in connection with this installation is, that the contract was completed in less than the time stipulated in the agreement with the City Corporation. The light is supplied from the City of London Electric Lighting Company's mains, the consulting engineer for the work being Mr. W. H. Preece. Some lengthy and very severe trials have been made with the lighting; on the occasion of a children's *fête* it was running for eight hours; it was also on the whole time of the Lord Mayor's Banquet on Wednesday week; and on other occasions similar tests have been made, all of which were absolutely satisfactory.

The switchboards have been a very heavy item in the contract, and it is evident that no trouble has been spared to have them well made, but the main switchboard is exceptionally well finished, both as regards the electrical and mechanical points, and the mahogany case in which it is fitted. This switchboard, which is three-wire, connects to the Guildhall, Council Chamber, Library, Lobby and Reading Room. The voltmeters and ammeters are by Messrs. Nalder, Bros. & Co. An Elihu Thomson three-wire meter is employed. The switches are quick make and break action. An original idea of the contractors in the mahogany cases is the fitting of special brackets for fixing the case, so that when necessary to get at the back of the switchboard all that has to be done is to slightly lift and move forward the board. For each of the 14 large fittings in the Guildhall proper, two switches are used, half the number of lights being turned on with each. These fittings are very artistic, having in the centre ring 24 16-C.P. Edison-Swan incandescent lamps, and in both the circle above and the circle below this centre ring are 6 of 8-C.P. The roof lighting in the hall consists of 7 100-C.P. lamps. Twelve small lights are in the band gallery, and 12 under the gallery. In the Lobby there are suspended 16 25-C.P. lamps, in four groups, and a bracket bearing 3 16-C.P. lights.

The Council Chamber looks, perhaps, as well as any part of the buildings. The magnificent centre fitting has 78 lamps—60 of 25 C.P., and 18 of 16 C.P. There are also two chair fittings each with 13 16-C.P. lamps, and one in the reporters' gallery with 9 16-C.P. Twelve lamps of 16 C.P. are bracketed in the gallery, and a similar number of the same size are fitted in the corridors.

The Library is fitted with 14 pendants, each carrying three 32 C.P. lamps. In the bays there are 12 single 32-C.P. lamps, one to each bay. At the top of the cornice, on either side of the room, are 28 lamps of 16 C.P. Sixteen 16-C.P. lamps are fitted in the reading room.

At the front entrance to the Guildhall are clustered five 25-C.P. lamps. The total number of lamps at present fitted is 822.

The whole of the cable employed in the work is of 750 megohms per mile insulation resistance.

On the whole the contractors, Messrs. Lund Bros. & Co., of 355, Oxford Street, have executed the work in a very creditable manner, and everything is exceedingly well finished. The same firm have also a number of contracts in hand in the City, amongst which are the fitting of 44 and 45, Fenchurch Street, 5, Bank Buildings, and 323, Upper Street, Islington, at which latter place engines and dynamo are being put down for both arc and incandescent lighting.

CONTRACTS OPEN AND CLOSED.

OPEN.

Cardiff.—November 23rd. For old copper, &c., at the Corporation yard, for the Cardiff Corporation. Particulars from Mr. W. Harpur, M.Inst.C.E., borough engineer, Town Hall, Cardiff.

Claybury, Essex.—December 6th. For the installation of electric light at the London County Lunatic Asylum in course of

erection or completion at Claybury, Woodford, Essex, for the Asylums Committee of the London County Council. Printed forms of instructions for tender, tender contract (with specification and schedules annexed), and bond, and lithographed copies of the drawings can be obtained on application to the clerk of the committee, at the offices of the committee, 21, Whitehall Place, S.W., on or after 14th inst., on payment of £2, which will be returned on a *bona fide* tender being delivered within the appointed time, or on return of the forms and drawings before that time. Tenders must be on the printed form, and be accompanied by the printed forms of contract with the schedule thereto and bond, the schedule being first filled up in accordance with the instructions for tender, and the whole must be enclosed in a sealed cover and delivered at the offices of the committee by 12 noon on December 6th. The contractor will have to enter into a bond in the penal sum of £300, with two approved sureties each in £150, as security for the performance of contract. Mr. R. W. Partridge, clerk to the Asylums Committee.

India.—November 23rd. For the supply of copper plates, &c., for the East Indian Railway Company. Particulars from Mr. A. P. Dunstan, Secretary, Nicholas Lane, E.C.

CLOSED.

St. Austell.—The St. Austell Local Board have accepted the offer of Messrs. Veale & Co., Limited, to supply an electric lamp of 200 candle-power for the public fountain, for £5 per annum.

BUSINESS NOTICES, &c.

New Extension Plunger.—The illustration below shows a new extension plunger for converting any ordinary push into an

extension push, which has been brought out by the General Electric Company.

The Electric Light in the City.—The following is a note of some of the latest electric lighting work noticeable around the City. The premises of the Direct Cash Trading Company, 32, Queen Victoria Street, work being carried out by Messrs. Croggon and Co.—Premises of Mr. James Hill, 100A, Queen Victoria Street, work being carried out by Messrs. Lund Bros. & Co.—Premises of Rudolf Mosses's Agency, 18, Queen Victoria Street, E.C., being fitted up by the Brush Electrical Engineering Company.—Messrs. Strode and Co are fitting up the premises of Messrs. Slaughter & May, 16 and 18, Austin Friars.—This firm is also fitting up an installation in some new premises in Finch Lane.—Fitting work is being carried out in the premises of Messrs. Kerr, Stuart & Co., engineers, Bucklersbury, by Messrs. Fuller & Tate, of 29, Bucklersbury.—The Brush Company are at work in the premises of Mr. M. B. Roseberg, 39, London Wall.—Messrs. Rashleigh Phipps & Dawson, of Berners Street, W., secured the contract for fitting up the premises of Messrs. Fitch & Sons, Wormwood Street.—Messrs. Laing, Wharton & Down are fitting up 13, Fenchurch Avenue, Fenchurch Street, while the Brush Company are engaged on work at 9 and 13, and also at 4, Fenchurch Avenue.—Messrs. Nicholson, Bolton & Tyler, of Queen Victoria Street, are fitting 71, Eastcheap.—Work has recently been completed at 13 and 14, Abchurch Lane by Messrs. W. T. Goolden and Co.

The Electric Light in the West End.—Several new contracts are to be noted in this district, among which we may mention one at 79, Chancery Lane, W.C., which is being carried out by Messrs. Strode & Co.—The same firm have the contact for fitting up a large pile of residential chambers in Dover Street, Piccadilly.—Electric lighting work has also recently been completed in the premises of Messrs. Cunliffes & Davenport, 48, Chancery Lane, and in the premises of the Law Guarantee and Trust Society, 49, Chancery Lane.—Messrs. Keys & Co., of 4A, Lambeth Road, S.E., are fitting up 3, Grafton Street, W.

Catalogues.—A catalogue of designs for electric light fittings has been brought out by Munro's Electrical Manufacturing Company. A large variety of artistic fittings are illustrated in a very creditable manner, and altogether the book is a handy and interesting album of such fittings in many designs. We understand that all hammered and embossed work done by this firm is hand wrought, not machine stamped. We notice some very pretty patterns of wall brackets and flower lamps, and a novelty is the patent jointed shell bracket, which looks well and is also very useful. Roof-fittings, electroliers, table and floor standards, billiard and dining table fittings and pendants are also referred to in the catalogue. As a kind of supplement to this book—which is purely for illustrating purposes—there accompanies it a pamphlet giving prices of patent quick-break main switches. Another pamphlet illustrates and describes, and also gives prices of switches, switchboards, fuseboards, and similar apparatus.

Action for Electric Light Supplied.—At the Borough Court, Preston, last week, the National Electric Supply Company, Limited, sued John Coward, innkeeper, Preston, for £14 6s. 9d. for light supplied. In June last year the electric light was put into defendant's premises. He paid his first bill, and then when two other bills had gone in the defendant made complaints and tried to impugn the meter. The defendant had paid into Court £4 13s. 5d. The meter inspector stated that the price of a 16-C.P. light was about ½d. per hour, and a 32-C.P. was about ⅛ths of a penny per hour. Mr. Coward had five 32 and two 16. The meter inspector reckoned Mr. Coward his bill on these rates, and it came right to a few shillings. A verdict was ultimately given for the plaintiff company for £13 6s. 9d.

Personal.—Mr. Charles Hibbert has resigned his position of works manager to the International Okonite Company.

Mr. Edwin Blakey, M.I.E.E., informs us that some time ago he severed his connection with Messrs. Blakey, Emmott & Co., Limited, with whom he had been identified for many years, and he is now practising at 21, Tanfield Chambers, Hustlergate, Bradford, as a consulting engineer and electrician.

Mr. H. F. Lewis, who was for several years manager and secretary of the Western Counties and South Wales Telephone Company, now amalgamated with the National, has been offered and has accepted the position of general manager to the London Electric Supply Corporation. Mr. Lewis will commence his duties on the 1st prox.

Action by King, Brown & Co.—Messrs. King, Brown and Co. have taken out an action against Mr. James Codie Gray, headmaster of Blair Lodge School, Polmont, in which they sue defendant for £100 as damages. In August last Messrs. King, Brown and Co. agreed to make additions to the electric lighting installation in the school for £622, but in September the defendant refused to allow them to proceed with the work, therefore they sue for damages in respect of breach of contract. Mr. Gray states that no complete agreement was made, for the reason that he never could get the plaintiffs to undertake to have the whole of the work concluded by October 1st, when the school opened for session. The case has been sent to the procedure roll.

Presentation to the New Telephone Company's Manager.—The employés of the New Telephone Company met at the company's Manchester offices on Monday evening, and presented Mr. G. J. Somerville with a silver tea service on the occasion of his leaving Lancashire, where he has been manager since the opening of the exchange early last year, to take charge of the company's Metropolitan district. In making the presentation Mr. W. A. Valentine referred to the esteem in which Mr. Somerville was held by all the employés of the Company, and said that the great progress of the exchanges in the Lancashire district was in a large measure due to his untiring energy. Mr. W. A. Valentine has been appointed district manager of Lancashire.

Roper's Electrical Engineering Company, Limited.—The business hitherto carried on at Bradford under this title, is being continued by Messrs. Rosling and Matthews, who were managing directors of the limited company, which, at meetings held on October 19th and Novemher 4th, it was decided to voluntarily wind up. They are conducting the business on the same lines as before, in their own names, and are, we understand, full of work, a number of machines being in course of construction to the orders of electrical firms in different parts of the country. The Sheffield agents of the firm, Messrs. Hattersley and Davidson, show at the Industrial Exhibition now being held in that town a 25-light plant, lighting their own stall, and they also light a stand for Messrs. Wheeler & Wilson.

Sales.—On Tuesday last, November 15th, a sale by public auction was conducted by Messrs. Wheatley Kirk, Price & Goulty, at the Albion Hotel, Piccadilly, Manchester, of the works, machinery, patterns, stores, and other stock of Messrs. T. Barraclough & Co., Limited, Globe Works, Manchester, which company is in voluntary liquidation. Messrs. Wheatley Kirk & Co. have also in hand for sale as a current going concern the old established engineering business of Messrs. Scriven & Co., of Leeds Old Foundry, Leeds. A large quantity of fixed and loose plant and machinery, patterns, and general stock, also the freehold of the land and buildings, is to be disposed of.

Train Lighting.—We hear that the Electrical Power Storage Company, Limited, have received an order for accumulators for lighting a further seven trains on the London, Brighton & South Coast Railway. This company has already 23 trains lighted, and with the seven now in hand, will have 30, which are expected to be in use after the commencement of the year. In addition to this their telegraph superintendent, Mr. Houghton, states that there is every possibility of a very large extension in the near future.

Electric Lighting of Mills.—Extensive mills at Bathpool, Taunton, belonging to Messrs. Redler, have recently been fitted with the electric light. The interior of the mills and stables is lit by incandescent lamps, and the exterior by an arc lamp of 2,000 candle-power. The Newton Electrical Engineering Company satisfactorily carried out the installation.

Mr. William Davison, of the East Mills, Morpeth, has just introduced into his recently improved mill there, an electric light plant, which illuminates the whole of the premises, including his dwelling house. The work, which has been successfully carried out and is now in full operation, has been accomplished by Messrs. Wynne and Barnard, Grey Street, Newcastle. There are 25 16-candle-power lamps, which light the house, mill, stables, &c.

A number of electric lighting installations has lately been fitted in flour mills by Messrs. Christy Brothers. This firm are at present erecting a very complete plant, consisting of 200 lights, in the Deptford Bridge Mills, Greenwich, for Messrs. J. and H. Robinson.

Sports by Electric Light.—Messrs. Mavor & Coulson, of Glasgow, have lately fitted up the cycle track and athletic grounds of Messrs. M'Quiston & Lang, at Ayr, with the electric light, and on a semi-public trial it has proved very successful. The Town Council of Ayr some time ago obtained a provisional order for lighting the town, but they have been outstripped by private enterprise, and a number of business men are having private installations fitted up.

New Branch.—Messrs. B. Verity & Sons have opened a branch electrical department in Manchester, at 29, Princess Street.

The Unbreakable Pulley and Mill Gearing Company, Limited, of West Gorton, Manchester, in order to facilitate their increasing business in London and the South of England, have opened offices and showrooms at 56, Cannon Street, London, E.C., where they have a very large and varied stock of their standard articles.

Telegraphic Communication at Hampstead.—The Hampstead Vestry have decided that from and after March 26th next, the maintenance of the electric bells at the Vestry Hall, and of the telegraphic communication between the Hall and Stoneyard, at present carried out respectively by Messrs. Strode & Co. and Mr. Frederick Brown, be included in one contract.

Shoreditch Electric Lighting.—Mr. E. Manville, 39, Victoria Street, Westminster, has, on behalf of his firm Messrs. Waller & Manville, been appointed consulting engineer to the Vestry of St. Leonard's, Shoreditch, to advise them on their proposed electric lighting undertaking.

Change of Address.—Messrs. McInnes, Ledbetter & Co. inform us that owing to increase of business, they have removed from Magenta Street, Woodgate, Leicester, to more convenient premises situated at Stamford Street, in the same town.

Edison Lalande Batteries.—The General Electric Company, we understand, have been appointed sole European agents for the Edison Lalande batteries. All applications, &c., should therefore be addressed to them at 71, Queen Victoria Street.

Diary.—We have received a copy of the "Mechanical World Pocket Diary and Year Book," for 1893.

CITY NOTES.

The West India and Panama Telegraph Company, Limited.

THE thirty-first ordinary general meeting of the above company was held at Winchester House, Old Broad Street, E.C., on Tuesday last, Mr. C. W. Earle presiding.

The SECRETARY (Mr. R. T. Brown), having read the notice convening the meeting, also the minutes of the previous meeting,

The CHAIRMAN said he presumed they would take the report as read. Although it was a report announcing a decrease of £3,762 in receipts, and an increase of £3,721 in expenditure, it was a somewhat better account, on the whole, than he anticipated, when they were discussing the effect of the reduction they had been impelled to make this time twelve months ago. If they had asked him twelve months ago whether they were going to pay even the insignificant dividend of 6d. a share this year, he would certainly have said he thought not, and when they came to their report and meeting in May last, and had to announce then a decrease of £7,350 in their traffic receipts, he was still more confirmed in the unfavourable view that he then took of the position. However, it appeared from their report that this six months they had only had a decrease of £3,762, which was very much less than they expected to have. In comparing the different periods with a view to ascertaining to what extent the diminution made in June, 1891, had affected their receipts, there was always the uncertain factor of the ebb and flow of West Indian trade, and he thought probably that the trade of the period upon which they were reporting was better in the West Indies than that of the corresponding year. However that might be, he felt pretty confident himself that the reduction they made in the tariffs—a very considerable reduction, amounting pretty nearly to 20 per cent. at most stations—had not produced a single extra message over their lines. That, he thought, they were all prepared for, because they knew very well that people did not telegraph when the messages were at all an expensive item, merely for the fun of the thing; they only sent messages that cost them several pounds when there was a matter of very great importance to be dealt with. He therefore anticipated that the reduction in the tariff, on account of competition, would have no effect in increasing the volume of traffic. He thought their competitors, who invaded their field in so unnecessary a way, must now be rather sorry that they ever spent their money in laying cables to the West Indies. Their report last June was a very gloomy affair, and he expected next year they would see it somewhat worse. Their cable to the Brazils was now broken down; it had brought them very little traffic, yet he thought it was a great loss to them, and if they endeavoured to repair it, it would be a very great expense. At present, they had no ships upon the West Indian station for repairing purposes, and no arrangements to send a ship to repair that Brazilian cable. Looking to the expenditure side of the account, and into the details of the repairs to cables which were summarised as to cost in abstract C, he found that they had 15 interruptions during the half-year, as against seven in the same period of last year, and that they used 190 knots of cable in effecting those repairs, as against 44 in the corresponding period of 1891. That, of course, explained the very large increase in the expenditure upon cable repairs. The principal offender amongst those 15 cables that were interrupted was the old cable between Jamaica and Porto Rico. That cable failed in a very great depth of water—2,234 fathoms—and as it was an old cable, having been down 23 years, it was found not to have sufficient mechanical strength to enable the ship to lift it to the surface; it was constantly breaking. The consequence was their ship had to go along by the cable until they came to ground where the soundings were more favourable, and the points at which they did get the cable, necessitated a piece of 85 knots being laid in to effect repair. A somewhat similar case, only to a very much lesser extent, occurred on the Grenada-Trinidad cable, and in that case only 19 knots were expended; but as both those repairs really amounted to renewals, they had followed the practice that they had always done upon similar cables of repairs of such magnitude, and had charged the cost of the cable so expended to the reserve fund. The report announced that the steamship, *Grappler*, had been ordered home to London to be surveyed, and to be fitted with a new boiler. That vessel had been actively in service for the last 12 years, and after that time it was considered, both by prudent people and Lloyd's requirements, that the boiler must be renewed, and therefore they were having her home almost immediately to have the boiler replaced with a new one. After referring to the vacancy occurring on the board by the death of Mr. Ford, he formally moved "that the directors' report and accounts to June 30th, 1892, submitted to the meeting be, and the same are hereby received and adopted, and as recommended by the board, dividends of 6s. per share on the first preference shares, 6s. per share on the other preference shares, and 6d, per share on the ordinary shares, the last free of income tax, be, and the same are hereby declared."

Sir JAMES ANDERSON seconded the motion, and after a few questions had been asked by the shareholders—one of which questions drew from the chairman the remark that the traffic receipts as near as possible from June 30th this year to the present time were £1,700 more than up to the previous date last year, the resolution was unanimously adopted.

A vote of thanks to the chairman and directors terminated the proceedings.

Western Union Telegraph Company.—The Western Union Telegraph Company of the United States have published a report for the year ended June 30th last. They also give comparisons of the three preceding years. Within the last four years the receipts have increased from 12 to 15 per cent. During the last year the company have opened 602 new offices and erected 26,200 kilometres of new lines. This company altogether possess 1,190,000 kilometres of wire and 20,700 offices, and have transmitted during the year 62,000,000 messages. The amount received per message is 1.58 fr., and the expense 1.12 fr.

The Swan United Electric Light Company, Limited.—The directors have resolved to recommend the shareholders to declare a dividend as follows for the year ending September 30th:—4s. 2½d. per share on the 78,949 ordinary shares of the company, £3 10s. paid; and 4s. 11½d. per share on the 19,750 £5 fully paid shares, free of income tax. This, together with the interim dividend paid on May 31st last, will make a total distribution of 10 per cent. for the year on the ordinary £3 10s. paid shares of the company. The dividend will be paid upon the register as it stands this day, and the warrants will be issued on December 13th next.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending November 13th, 1892, amounted to £945; corresponding month, 1891, £819; increase £126; total receipts to date, 1892, £16,108; corresponding period, 1891, £14,575; increase £1,533.

The Western and Brazilian Telegraph Company, Limited. The receipts week ending November 11th, after deducting 17 per cent. of the receipts payable to the London Platino-Brazilian Telegraph Com Limited, amounted to £2,816.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.	Closing Quotation November 10th.	Closing Quotation, November 17th.	Business done during week ending November 17th, 1892. Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 —103	100 —103	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	50½ — 51½	50½ — 51½	50⅝	...
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	91 — 92	91 — 92	92	91
2,876,140*l*	Do. do. Deferred	Stock	11½ — 12	11½ — 12	11⅝	11½
130,000	Brazilian Submarine Telegraph, Limited	10	10⅞ — 11¼	10⅞ — 11¼	11⅛	10 15/16
53,200*l*	Do. do. 5 p. c. Bonds	100	101 —104	101 —104	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	104 —108	105 —109	107	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3 — 3¼	3 — 3¼	3¼	3
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2¼ — 2⅜	2¼ — 2⅜	2⅜	2⅜
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	3 7/16	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	2¼ — 3⅛	3 — 4	3⅜	3⅜
30,152	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152 ...	10	10⅞ — 11¼	10½ — 11	11	10⅞
$7,716,000	Commercial Cable, Capital Stock	$100	174 —176	181 —183	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	¼ — ⅜	¼ — ⅜	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos 1 to 20,000	5	5¼ — 5⅜	5½ — 5⅝	5⅝	...
16,000	Cuba Telegraph, Limited	10	11½ — 12½	11½ — 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	17½ — 18½	17½ — 18½	...	...
12,981	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3 — 3½	3 — 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11½ — 11⅝	11½ — 11⅝	11 11/16	11½
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅜ — 15½	14⅜ — 15	15 1/16	14⅜
70,000	Do. 6 p. c. Preference	10	15⅜ — 16¼	15⅜ — 16¼	16⅛	...
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	109	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	109 —112 xd	109 —112	110⅜	110
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	14⅞ — 15¼	14⅜ — 15	15⅛	14⅜
70,600*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	104 —107	104 —107	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	104 —107	104 —107	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	109 —112	109 —112	111½	...
122,400*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	103 —106	104 —107	105⅜	...
163,700*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	103 —106	104 —107	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	103 —106	103 —106	104	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	3½ — 4	3⅜ — 4¼	4	3 13/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	⅜ — ⅝	⅜ — ⅝	⅜	¼
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	1⅛ — 1⅜	1¼ — 1½	1⅜	1⅜
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	⅝ — ⅞	⅞ — 1	0 15/16	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	3 1/16	2 15/16
180,227	Globe Telegraph and Trust, Limited	10	10 — 10½	9⅞ — 10½	10 3/16	9¾
180,042	Do. do. 6 p. c. Preference	10	15½ — 15⅝	15 — 15½	15 3/16	15
150,000	Great Northern Tel. Company of Copenhagen	10	18¾ — 19¼	18¾ — 19¼	19⅛	18 15/16
210,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	5½ — 6½	4½ — 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½ — 10½	9 — 10	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½ — 22½	21½ — 22½	21⅞	21¾
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	43 — 45 xd	43 — 45	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½ — 3½	2½ — 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	3 7/16 — 3 9/16	3 7/16 — 3 9/16	...	...
10,000	Do. do. fully paid	5	5 1/16 — 5 3/16	5 1/16 — 5 3/16	5⅛	4¾
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	107 —110	107 —110	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½ — 7	6½ — 7	6⅝	...
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	104 —107	103 —106	...	...
447,234	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜ — 5	4⅜ — 5	4 15/16	4⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	14 — 14½	14 — 15	14½	14⅜
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13½ — 14	13½ — 14	...	...
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	111 —113	111 —113	113	111½
48,000*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	3⅜ — 3⅞	3⅜ — 4⅛	4 1/16	3 15/16
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 — 6	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	1/16 — 1/16	1/16 — 1/16	...	...
10,802	Reuter's Limited	8	7 — 8	7½ — 8½	8⅜	7⅞
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8 — 8⅛	8¼ — 8⅜	8⅜	8 7/16
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8¼	...
3,361	Submarine Cables Trust	Cert.	117 —121	117 —121	117½	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3¼ — 3⅜	3¼ — 3⅜	3 13/16	3¼
37,350	Telegraph Construction and Maintenance, Limited	12	45 — 47	45 — 47	46½	46
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	103 —106	103 —106	...	...
58,000	United River Plate Telephone, Limited	5	2½ — 3	2⅝ — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 — 100	90 — 100	...	..
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½ — 7½	6½ — 7½	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	100½	...
30,000	West Coast of America Telegraph, Limited	10	3 — 4	2½ — 3½	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	103 —107	103 —107	...	...
64,242	Western and Brazilian Telegraph, Limited	15	8⅛ — 8⅜	8 — 8⅛xd	8 1/16	8 1/16
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	6 — 6½	6 — 6½xd	6 7/16	6⅜
33,129	Do. do. do. 5 p. c. Deferred	7½	2¼ — 2⅜	2¼ — 2⅜	2⅜	2¼
184,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	105 —108	106 —109	...	...
230,100*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	105 —108	106 —109	...	...
88,321	West India and Panama Telegraph, Limited	10	1¼ — 1½	1¼ — 1½xd	1⅜	1 5/16
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10¼ — 10⅜	10 — 10⅛xd	10⅛	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	8½ — 9½xd	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	103 —106	104 —107	...	...
1,536,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125 xd	120 —125	...	...
171,000*l*	Do. do. 6 p. c. Sterling Bonds	100	100 —103	100 —103	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½ — 6	5⅝ — 6¼	5 15/16	5⅝

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. BANK RATE OF DISCOUNT.—3 per cent. (October 20th, 1892).

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid) 7⅜—7⅞.—Electric and General Investment, shares of £5 (£1 paid), 2⅜—3⅛.—Founders' shares, 200—225.—Elmore Foreign and Colonial Copper, Founders shares, 6⅜—7⅛.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20⅛.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 2⅛—3⅛.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5—5⅛, 1st Preference Cumulative 6 per cent., £5 (fully paid), 5⅛—5⅜.—Liverpool Electric Supply Shares of £5 (fully paid), 5 1/16—5 3/16.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—⅛.—Do. 4½ per cent. preference shares of £10 (fully paid), 10—⅛.—Do. Debentures, 103—⅛.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), ⅛—¼.—£5 Preference (fully paid), 2¼—3.

LEGAL.

THE THREE-WIRE SYSTEM.

DR. JOHN HOPKINSON *v.* THE ST. JAMES'S AND PALL MALL ELECTRIC LIGHT COMPANY, LIMITED.

(*Continued from page* 585.)

FOURTH DAY—NOVEMBER 5TH.

SIR HORACE DAVEY, Q.C., resuming his speech, said he would concede that what Dr. Hopkinson had in view was the parallel arrangement; but, like most patentees, in his experience, he had endeavoured to frame his specification in such large terms that it would comprise arrangements in addition to that which he had principally in his mind. Now that the patentee desired to defend his patent, he wanted to put as narrow a construction as possible upon it. But if the Court had before it a case where a person was using the three-wire system with two electromotors placed in series, did they suppose for a moment that Dr. Hopkinson would say that such an arrangement was not within his patent? He (Sir Horace) did not think, as a question of infringement, the question would be arguable. He paused there to comment on what was said by Lord Kelvin, that distribution at the date of this patent had a technical meaning, that it meant in the language of an electrician a system of distribution to incandescent lamps by an arrangement in parallel. He (Sir Horace) should have thought distribution was a perfectly well-known word in the English language, and meant distributing the electric current to be applied to customers or consumers amongst them; just in the same way as a milkman who went round in series and left his pot of milk at each customer's door, might be said to distribute his milk for the use of customers. He was told that numerous examples might be produced in text-books of authority, where the word "distribute" was used with reference to electricity, not in the narrow and technical sense which Dr. Hopkinson and Lord Kelvin attributed to it, but in the ordinary and proper sense of supplying the points where the electricity was to be consumed. He did not think it necessary to dwell very much, in his opening at any rate, on that point, because the patentee, apparently thinking that people might attribute that narrow and technical meaning to "distribution," carefully used the word "supply." He said, "The application of this instrument to an extended system of electrical supply with a network of distributing mains, is important." With reference to fig. 5, he (Sir Horace) should not say that did not represent a system of parallel arrangement. But when a thing had to be represented by a figure, some particular instance of it must be taken; it must be an arrangement in parallel or in series, or some combination of the two. It was familiar to everybody, that you could not form a picture of a general idea; a particular example must be taken. He could quite conceive that the patentee, having the parallel arrangement particularly in view, desiring to show a diagrammatical instance, would naturally show it in the form of a parallel arrangement. But the question was, whether the description, as given in the letterpress, was not such as to go beyond the parallel arrangement and to include other arrangements as well as the particular one by which the patentee illustrated his general description. His (Sir Horace's) submission was, that it did.

Mr. JUSTICE ROMER: The question is, whether it includes something beyond parallel.

Sir HORACE DAVEY: Yes. It is remarkable if the patentee intended to confine it to parallel, he did not say so. It would be so easy to say "any parallel system of distribution."

Mr. JUSTICE ROMER: Where the lamps are in series, it is said that the central wire does not carry the difference of current, but what it carries is nothing, or the whole. I want to know how you meet that.

Sir HORACE DAVEY said exactly the same thing would apply to the case of incandescent lighting. It was perfectly possible that the whole of the incandescent lights in one division might be put out, leaving all or some of those in the other division alight. It might be that would not practically happen in a large system of distribution such as they were familiar with in London; but this was not confined to large systems. For the purpose of discussing this question, however, he was not bound by arc lights. The patentee told the public his invention was to be used for any electricity-consuming appliances, and even if in one particular instance it would not work with arc lights, that was not conclusive by any means: there were arc lights and arc lights. Arc lights were not by any means the only electricity-consuming appliances. What did the plaintiff say to electromotors which were required to do 10 horse-power. If he had not his third wire, the whole current would pass through the whole system, but if he had his third wire, the excess of current which was not required passed down the centre wire. Nobody, he thought, would venture to say that if you had two electromotors which you wished to supply from a single circuit, that the most advantageous way of doing it would not be by the use of the third wire. By his specification the plaintiff practically said, "Look at my claim and my description; it is true the illustration I have given you was an illustration of the way in which it would be used in the majority of cases, but I carefully abstain from saying I confine it to that particular system." The comic thing that struck him (Sir Horace) throughout this case was, that his learned friends supporting the patent were endeavouring to show it was not useful for a particular application, and he was supporting their patent by showing its utility. (Laughter.) That was an inversion of the argument which he had not experienced before. Supposing his learned friends showed that the plaintiff's invention was no use for arc lighting in series, but that according to the true construction of the patent, are lighting was included in the patent, he would not foreshadow the result to the patent. What was the claim? He submitted it was meant to cover everything which would come within the letterpress illustrated by fig. 5. If he was right in saying that the letterpress description in the specification was distinctly framed in such terms as to include not only the particular example of which the illustration was given in fig. 5, but all cases in which there was an intermediate conductor and an electricity-consuming appliance placed between the positive lead and the intermediate conductor, then they must give the patentee the benefit of including in his specification everything his description included, notwithstanding he had by his illustration given a particular example of what were intended to be incandescent lamps in the drawing in the parallel system. If the patentee was not confined to his lamps, why was he confined to the parallel system? He (Sir Horace) agreed that this was a case of evidence. He was instructed that in the winter of 1881 Mr. Crompton's firm had instructions to light the Alexandra Palace with the arc light, and that, wishing to economise copper, he proposed to use two circuits, two arc lights, and two dynamos, but with a common conductor. But you could not make two dynamos absolutely synchronous, nor having absolutely the same speed, and Mr. Crompton found that with the two dynamos coupled in series one dynamo reversed the other, so that they became in series, and it became one circuit, and instead of the current from this dynamo coming up this wire and returning by that wire, it went the other way—down this wire. Being unsuccessful in counteracting this, Mr. Crompton said, "Let the dynamos remain in circuit;" and the dynamos were allowed to remain in that state during the winter of 1880-81, until the installation was taken down.

Mr. JUSTICE ROMER: Were there only two lamps in that particular case?

Sir HORACE DAVEY said there were only two arc lamps. He believed his Lordship would hear evidence to the effect that this arrangement, which was hit upon by accident, not by design, was found to work exceedingly well, and was found to give particular advantages in point of economy. The Inchicore installation was a single dynamo, but wound on two coils on a single armature, which the patentee agreed was the same thing as two dynamos coupled in series by a rigid connection. It was used for the purpose of lighting arc lamps in series, but his Lordship would be told that by means of switches it would not only be perfectly possible, but would be the natural use of it, to switch it into a parallel system His Lordship would have to consider how far on the question of anticipation it was enough to say that could be done; he (Sir Horace) was only in a position to prove actual user in the form of arc lights in series. It was stated in the particulars of objection that others were supplied by Messrs. Siemens at exactly the same time. He (Sir Horace) would call workmen who made them in Messrs. Siemens's works, and would produce letters from the persons who received them. Within the last few days, the gentlemen who instructed him received an intimation of another installation which was furnished by Messrs. Siemens of the same character as the Inchicore. That was furnished to the National Electrical Company in Glasgow (a body incorporated for some purposes connected with electricity), of which a gentleman named Joseph Davenport Andrews was the manager. The dynamo which was furnished by Messrs. Siemens was of the same character as the Inchicore, but the National Electrical Society, for some purpose of their own, altered it in their works, and, instead of using it with arc lights in series, used it (as he was instructed) in parallel with incandescent lamps. They so used it for about four months, from about March 11th, 1882.

Mr. JUSTICE ROMER: Openly and publicly used it?

Sir HORACE DAVEY: Yes; in their works. I do not know the exact date, but it must have been before March, 1882, because I have a letter complaining of some defect in the thing. The company, apparently, was not very successful, and, like some other companies, failed, and was wound up.

Mr. JUSTICE ROMER: This is, in other words, an absolute anticipation—free from all the difficulties of proving it?

Sir HORACE DAVEY said that if the plaintiff's invention was confined to the parallel arrangement (which he protested against) this, if his instructions were correct, was an absolute anticipation. Of course, the evidence would have to be carefully sifted, and he made no complaint if his learned friends required very strict evidence of it. He therefore submitted that if he proved the Inchicore and Alexandra Palace user, he had proved enough, while if he had proved the Glasgow user admittedly that was an answer. The learned counsel then contended that, having the three-wire system applied to lamps in series, it required no inventive faculty to turn those lamps into parallel, a thing which he had a right to do. There might, he said, be an important discovery made by Dr. Hopkinson, but every discovery was not the subject matter of a patent. Merely telling a person they would derive particular advantages from using an arrangement they already had in a particular way by making a change which everybody knew how to make, although it might be a most important discovery, and most valuable, would not be proper subject matter of a patent. In support of this proposition he cited the case of Ralston *v.* Smith (11 House of Lords case, page 223) and the judgment of Lord Justice Kay in the recent Lane-Fox case. Further, he said if the patentee said his invention could be used with continuous dynamos or with alternate dynamos, and it turned out it could only be used with one, the specification was bad. That was the law—it might be the hard law—laid down in the Analine dye case. Mr. Wylde, a gentleman distinguished in the scientific world, told the world in 1879 what Dr. Hopkinson told it in 1882, namely, that where dynamos were continuous, and it was desired to work them in series, it was not necessary that they should be rigidly coupled. If that were so, it was obvious that the arrangement of fig. 5 was equally applicable to alternating currents. The ordinary mode of coupling dynamos in series which would be adopted by the workman, would not effect the object. It was quite true that if experiments were

tried, the electrician, by whose directions the workman was guided, would find that the ordinary coupling was insufficient for the purpose, and would hit upon the expedient of coupling them together by rigid connection. But that was exactly what the Patent Office said must not be left to the workman. The Patent Office said that directions must be given to the workman sufficient to enable him to carry out the invention without trial, and without failure. He (Sir Horace) ventured to submit that it was a clear proposition of patent law that if a patentee, having described his instrument with reference to continuous machines, said it was obvious the same thing would apply to alternating machines, and it turned out that the workman would require to discover and rectify the cause of failure, that made the patent void, for the reason that the monopoly was granted on the condition that the patentee should describe the mode in which his invention was to be carried out. Apologising for the unavoidable obscurity of an advocate in dealing with such technical matters, and the length of his opening, he would proceed to call evidence in support of the defendants' case.

MR. JUSTICE ROMER said: Sir Horace's speech was a great assistance to the Court, and not one whit too long.

WM. LEWIS CRESWELL, examined by Mr. FINLAY, said that he was foreman of the Hydraulic and Electric Lighting Departments of the South Western Railway Company at Inchicore. He remembered the machine coming from Messrs. Siemens in March, 1882, being erected. That machine was in the same condition, and had been used in the same way, from that time to the present. The diagram (J. H. 8) represented the working of the machine.

Cross-examined by Mr. ASTON, WITNESS said he had been at Inchicore all the time.

Mr. EDWARD LAUCKERT, examined by Mr. FINLAY, said he was the workman's manager of the electric lighting department of Messrs. Siemens. He had been in that department since 1880. It was under his directions that the machine supplied to Inchicore was wound. The machine was connected on what was now called the three-wire system. It had three collecting rings and two circuits connected with those rings, with a third wire in the centre. The diagram correctly represented the working of the machine. The third wire only conveyed the difference in current between the two circuits; if only one circuit was burning it conveyed the whole current of that circuit. He gave directions for the winding of the machine on January 4th, 1882. It was sent from Woolwich on that date, directions being given to erect the machine in accordance with the diagram. On January 18th, 1882, he gave directions for the winding of a similar machine erected for the National Electrical Company, of Glasgow. That was delivered on March 1st, 1882, arriving at Glasgow in the course of a day or two. He had made a calculation as to the saving of energy in machines made that way, with the result that he found there was a clear saving of 414 volts.

The WITNESS was cross-examined by Mr. MOULTON, Q.C., as to the saving of energy. The result was almost unintelligible.

Mr. JUSTICE ROMER said it was perfectly clear that if witness had to work two sets of lamps of five each in the ordinary way, he would have to use four wires; in this way of working three only would be used.

To the WITNESS: You say that even when two sets of five each are burning there is some electricity comes back by the central wire if the lamps are not burning quite the same brightness?—Yes.

Mr. JOHN NEBEL, in the employ of Messrs. Siemens, agreed with the description of the machine given by Mr. Lancket.

Cross-examined by Mr. MOULTON, Q.C.: Messrs. Siemens and Halske (?), in Germany, were, be believed, connected with Messrs. Siemens in England. He could not say whether Siemens in Germany were licensees under Dr. Hopkinson's patent. He did not know of an application by Dr. Siemens to patent the three-wire system in this country, nor of an application to patent it in Germany. He had not seen Mr. Siemens in Court.

WILLIAM SHARINER, examined by Mr. FINLAY, said he had been in the employment of Messrs. Siemens for many years. He was in their employment in 1882, and was employed by them to start the Inchicore installation. He set it up as it was sent over, and the diagram represented the arrangement as nearly as he could recollect.

Mr. THOMAS B. C. NUTTALL, also in the employ of Messrs. Siemens, said he took the measurements on which Mr. Lancket's calculations were based. He agreed with that witness's evidence.

Mr. WILLIAM HENRY ILLINGWORTH, examined by Mr. FINLAY, said that in the year 1880, he was in the employ of Messrs. Crompton, the electrical engineers. During that year Messrs. Crompton had an installation at the Alexandra Palace. The installation was a portable plant. It was used in the summer time in lighting the grounds, and afterwards to light the Palace itself. That would be the winter of 1880, and part of the spring of 1881. The plant consisted of a portable engine, four dynamos, and Crompton lamps. The lamps were series-wound lamps, without the shunt. The output of the dynamos was about 50 volts, or probably a little more, and 20 ampères. Two of the dynamos were arranged to run in parallel, with a common return. When they tried to work in this way, the machines reversed themselves, and ran in series. They continued to work in that way, rearranging the terminals of the lamps, for probably three months. The dynamos and engine were placed at the end of the deliverance platform, and the arc lights themselves were in the central hall of the Palace. They could be seen by anybody, but for a tarpaulin which was put up in front of the machinery. The arc lamps burnt very well in series.

In cross-examination by Mr. MOULTON, Q.C., WITNESS said Mr. Crompton knew when those machines first reversed.

The hearing of the case was, at this stage, adjourned until Monday.

FIFTH DAY.—NOVEMBER 7TH.

Mr. ROOKES EVELYN CROMPTON was examined by Sir HORACE DAVEY, Q.C. He said that he was the head of the firm of Crompton and Co., engineers and electrical appliance manufacturers. He was the head of that firm in 1880. In 1880 he had a contract with the then lessees, Messrs. Willing & Co.—who were lessees for a year only, he believed, to light certain portions of the Palace grounds. They commenced work in June or July, 1880. The installation was employed for lighting what was called the central hall transept, and at other times it was employed for lighting the grounds. He put up a great deal of the installation with his own hands, as was usual in those days. The installation consisted of a portable apparatus specially designed by him for the purpose of being taken about from one place to another, with a view of making the electric light as popular as possible. There was a portable engine with a tumbril attached to it, and on the tumbril were mounted four Gramme dynamos of the A type. These were series-wound dynamo machines for supplying a continuous current. On the tumbril were mounted two drums for the purpose of making the coils of copper portable and of uncoiling the cable to a sufficient extent to carry it to the point where the light was required to be delivered. As his apparatus was quite new, and he did not wish to cut those cables, he purchased a coil of copper wire and determined to use this as a common return. He proposed to use his two cables on the drum as the two outgoing flow conductors, and to use the copper wire as a common return. He coupled two dynamos to the three conductors he had mentioned, so that he had two circuits with a common return. The lamps lit up, but showed that something was wrong. [The witness produced a diagram illustrating the arrangement he intended to use.] Immediately they switched lamps on they found the poles had reversed. Thinking there was a mistake on the part of whoever put the terminals into the lamps, the poles were reversed, but they kept on being always in the wrong way. This occurred whilst he was present. He found after reversing one lamp that the lamps burned very well, and then he discovered that the two mains were in series. Fig. 2 represented a diagram of the arrangement when the alterations he had mentioned had been made. The lamps burned well in that manner for several weeks, he might say months. The installation was moved within the Palace grounds three or four times. The arc lamp used in that arrangement was a lamp he had worked out himself; it was the fourth type of lamp he had invented, and the latest type of lamp they used previous to the use of differential coils. Those lamps on the ordinary two-wire circuit would not burn in series—they would invariably go out each time the lamps had to feed. On the three-wire system these lamps burned satisfactorily; without the central wire they were no use for lighting purposes. He was speaking from painful experience. One advantage of the use of the third wire in the manner he had described was that it enabled the difference of the currents of two lamps to be dealt with by the dynamos exactly in the same way that the difference between the currents of the two parts of the three-wire system were now dealt with by the dynamos. It also enabled the two lamps to be burned in series by enabling different currents to exist in the different lamps, whereas without the third wire they must have identical currents in the lamps. And a further advantage was that he discovered there was next to no current in the middle wire, though it was not until later that he attempted to measure the current that passed. Yet another advantage was that though it was not worth his while to pull down the wire that was already in place and substitute a smaller one, it was evident to him that he could have reduced the size of the middle wire. He did not derive that advantage. What he did derive was the knowledge that there was no loss of energy through the current going and returning through that centre wire. He had the advantage of actually using three wires instead of four to get two circuits. For two years before 1880 he had been engaged in the manufacture of arc lamps.

We have been told that in the years 1881 and 1882 the use of arc lamps in parallel was unknown?—It was not unknown. It was considered extremely desirable to use arc lights in parallel. It was the first way of subdividing the electric light that suggested itself to users.

In 1882 had you manufactured arc lamps and arranged them on the parallel system?—I had manufactured André lamps. I do not think it is fair to call them arc lamps; they were semi-incandescent lamps.

Were there other lamps used on the parallel system prior to 1882?—I am not certain of the date of the Gülcher arc lamp, but the Gülcher arc lamp was worked in parallel circuit from its very commencement.

Cross-examined by Mr. MOULTON, Q.C.: The André was not a regulator at all was it?—It was more a regulator than the Werdermann.

Do you know of any public user, leaving out André and Werdermann, of these lamps in England before July 1882?—I know that lamps were sold by the Brush Electric Light Company, but I do not know where they went to.

Were not the lamps you used at the Alexandra Palace lamps with a series coil for striking the arc?—Yes.

And a shunt coil for regulating?—No; I am perfectly confident of that.

The dynamos were A Gramme dynamos, which were dynamos which could not be used for such things as parallel lighting?—We did all the incandescent work for the first year or two with them.

Hadn't they this disadvantage, that supposing you diminished the number of lamps on a circuit the dynamos had a tendency to lose their current?—If you carried it to an extreme point they did.

If you halved the number of lamps?—It made no difference.

That peculiarity led to their reversing?—That was probably one of the causes of their reversing.

This installation was in 1880. When did you first put up any installation on the three-wire system for parallel incandescent lighting?—That depends what you call the three-wire system. I have never put up any on Dr. Hopkinson's system; I used quite a different system.

When did you first put up a system of incandescent lighting in

which there were two dynamos or two secondary batteries in series and a wire acting as a common wire to the two systems of incandescent lamps?—I think the first time I used secondary batteries in that way would be in Vienna in 1886, in connection with a five-wire system.

Had you before used two dynamos in series with a common wire arranged like that?—I do not recollect having done so.

Will you tell me what installations you put up of incandescent lighting—when was your first?—I find that we had erected 2,000 odd incandescent lamps by the time Dr. Hopkinson's provisional specification was taken out. Nearly one-half of these were in one large installation at the Birmingham Town Hall, which was a five-wire compound parallel system, the wires not going back to the dynamo.

At that time had your attention been given to the question of economy in mains?—Yes.

Mr. MOULTON then read extracts from a paper read by Mr. Preece at the Society of Arts on March 7th, 1884, referring to the simultaneous discovery by Mr. Edison and Dr. Hopkinson of the three-wire system, and asked witness if in the discussion which followed the reading of that paper, witness (who admitted being present) suggested to anybody that he had ever discovered the three-wire system of Dr. Hopkinson.—WITNESS said that he thought he mentioned to Dr. Hopkinson, probably soon after the patent was published, that he had done something at the Alexandra Palace which he thought would invalidate his patent, but he was not prepared to say that at that public discussion he made any announcement that he had anticipated Dr. Hopkinson's patent. The learned counsel was about to cross-examine witness as to his connection with Mr. Massey, when his Lordship interposed and said he did not see the relevancy of that matter, and Mr. MOULTON proceeded.

Did you ever in incandescent lighting use the three-wire arrangement before the publication of Dr. Hopkinson's patent, or speak to anybody about it?—I always used at that time a compound parallel arrangement, and it was always my intention to use batteries with it. I considered Dr. Hopkinson's arrangement was an inferior one, and I hoped every day to bring out my own invention.

At the Glasgow post office did not you try to use your A Gramme dynamos with the common return?—Yes.

They were intended to work with a common return and they reversed?—We altered the connections specially to obtain the three-wire arrangement that I had at the Alexandra Palace, so that I could ascertain what current returned.

Have not you applied for a license under the three-wire patent?—I believe in one case at Manchester we asked what the terms would be, because we were ordered by the specification to take all risks. We said that in our opinion there was no risk.

Mr. JOHN SMITH RAWORTH, examined by Mr. FINLAY, Q.C., said that he had been the chief engineer to the Brush Electric Lighting Company since 1886. Before that time he was the agent of Messrs. Siemens, located at Manchester. While agent for Siemens, he fitted up the steamship, *City of Berlin*, with electric lighting apparatus. The work was commenced on November 29th, 1879, and the ship sailed for New York on December 4th. The machine was a Siemens' alternator or distributor wound in two circuits in series with three collecting rings. There were eight arc lamps, four in each series. The third wire acted in two or three different ways. In the first instance it acted simply as a divider of the two circuits so that they were able to burn the steerage or saloon lamps, or both; and that was of great importance. Then it acted as a protector of one circuit from the inequalities of the other. If the eight lamps had been in series together when the circuit was broken by one of the lamps parting its carbon too far, the whole of the lamps on the circuit would have gone out. By having this middle wire, when the lamps in the steerage played that game, the lamps in the saloon were unaffected. The potential came back to the dynamo through the middle wire, and the middle wire compensated to some extent for the increased locomotive force of the generator. Witness also fitted up the *City of Rome*, of the Inman line.

Mr. J. D. F. ANDREWS was then called. He said that he was an electrical engineer in Parliament Street. He was formerly in the employment of Messrs. Siemens, during which time he became acquainted with the mode of winding alternating current machines. After leaving Messrs. Siemens, he became manager of the National Electrical Company at Glasgow. This was in 1881. The machine of the National Electrical Company was received the first few days of March, 1882. He had satisfied himself by reference to documents that the machine was invoiced by Messrs. Siemens on March 1st.

Mr. ASTON, interposing, said that he understood that his Lordship had allowed the defendants to give evidence proving another instance of the user of a dynamo such as was used at Inchigore. The plaintiff's counsel were prepared to meet Mr. Andrews' evidence as to another machine, like that described in paragraph 13 of the particulars of objection, but if it went beyond that particular objection, they were not prepared to meet it.

Mr. JUSTICE ROMER said that he never meant to restrict the defendants so much as that.

Mr. ASTON said his Lordship's desire to elicit all the facts was well-known, and must be acted upon. All he should ask, if the defendants were allowed to go on, would be that the plaintiff might have an opportunity of considering the evidence which would be given as to any further or developed use, and of meeting it as they could afterwards.

Sir HORACE DAVEY said he could not admit that the plaintiff's counsel were taken by surprise, but he placed himself entirely in the hands of the Court, that was the most satisfactory course.

Mr. JUSTICE ROMER said he certainly should not be disposed to exclude the evidence tendered, but if it turned out that this was a user of the parallel arrangement—a clear anticipation—he thought it would be right that the plaintiff's counsel should have, and he should give them, the opportunity of considering their position, so that they might come and say they would not go on and ask him to deal with the costs on that footing. It would be right, he thought, under the circumstances that he should listen to any application the plaintiff might have to make to adduce rebutting evidence. Would the plaintiff's counsel make that application immediately, or cross-examine first?

Sir HORACE DAVEY said that it would be within his Lordship's recollection that in the cross-examination of Sir Frederick Bramwell and Lord Kelvin, a diagram was put to them of what Mr. Andrews was going to prove. That diagram showed incandescent lights in parallel. His Lordship used an expression which showed what was before his mind. The diagram represented the user of one of those series wound dynamos in connection with incandescent lamps arranged in parallel in the manner described in fig. 5. That being so, he could not admit that his learned friends had the slightest ground of complaint on the score of being taken by surprise. But he thought if his learned friends desired an adjournment they should make the application before they heard the evidence of Mr. Andrews. They knew what was going to be proved, and would it be quite right that they should hear the evidence first?

Mr. ASTON said the plaintiff's counsel thought, having regard to the form of Sir Horace Davey's application to the Court, and the significant manner in which his Lordship guarded the permission, that the new evidence was not to go beyond a further instance of objections enumerated in paragraph 13.

Mr. JUSTICE ROMER said plaintiff's counsel should not be taken at a disadvantage. If they told him as a fact that they were taken by surprise if the evidence went to the extent it was now said to do, he was willing to listen to an application that the hearing should be postponed, but he thought that application should be made at once.

Mr. ASTON said he had no right to anticipate what Mr. Andrews was going to say.

Mr. JUSTICE ROMER asked what would be the objection to the examination being taken, and the application made before the cross-examination began.

Mr. ASTON said he should be in a position to make the application as soon as he knew what Mr. Andrews really was going to say in evidence.

Mr. JUSTICE ROMER thereupon directed the examination of Mr. Andrews to proceed, saying that he would reserve all question of costs until the whole matter was before the Court.

Mr. J. D. F. ANDREWS was then further examined by Mr. FINLAY.

With what description of lamps was that machine used?—Incandescent lamps.

Is this a diagram prepared by yourself, Mr. Adams, showing how the machine was worked with the incandescent lamps?—This is substantially the arrangement used.

When did you prepare that diagram?—On Saturday afternoon.

You have there represented the alternating current dynamo, and then you have three wires proceeding from the dynamo. Taking the wire to the left hand as being the outgoing wire, have you groups of lamps between the outgoing conductors and the middle wire, and also between the other conductor and the middle wire?—Yes.

Mr. ASTON objected to the use by the witness of the diagram, on the ground that that course of examination was leading in its worst form. He submitted that the witness ought not to have in his hand a diagram of what he said he did.

Mr. FINLAY said he had handed Mr. Aston a copy of the diagram, but he would examine the witness without it.

Mr. JUSTICE ROMER pointed out that the witness made the diagram himself to explain to the Court what he did, and was now coming forward to state what he did. The witness could, of course, describe it without reference to a diagram, but it would be almost impossible to follow it. It was very useful that he should illustrate what he did. Where was the harm?

Mr. ASTON said he should ask his Lordship to take this possibility into consideration. The witness's memory would be seriously challenged, as between 1882 and 1892 he had done hundreds of things, and if he were going to fix at this particular date by means of this diagram that which he now said he did in Glasgow, of course his memory would be very much helped by the concrete form in which his recollection was expressed upon paper.

Mr. JUSTICE ROMER said he thought that the plaintiff would be sufficiently protected by cross-examination, but the witness should go back into the box, and he (his Lordship) would take the diagram.

Mr. FINLAY said he could examine witness without it.

Mr. ASTON: I am bound to say when we look at this diagram we have a good deal to meet.

Examination continued: You have told us the machine was used for incandescent lamps. For what purpose were incandescent lamps arranged in this circuit?—Partly for lighting the workshop and partly for the purpose of manufacturing.

Will you describe how the three wires were used in connection with this dynamo?—[The witness described a parallel arrangement.]

How many groups of lamps had you?—To the best of my recollection there were four or five circuits taken off those three wires.

Were they not arranged in parallel?—Yes. The number of lamps on the circuit was very irregular.

There was another set of lamps for lighting the workshop?—Yes.

Were they also arranged in parallel?—Yes.

Taking these two groups used for lighting, between what wires were they?—Each circuit was connected on the outside wire, and the two circuits were connected to the central wire.

Did you also finish lamps upon this circuit?—Not on those two circuits I have just mentioned, but in connection with the three wires. The finished lamps were hung on frames at the end of the room.

How many lamps were used on these two circuits you have spoken

of for lighting the room?—To the best of my recollection there were eight or ten.

How many lamps were on the circuits?—They varied.

How many circuits had you, usually, of these lamps?—Not more than five.

How many finished lamps would be hung up at the end of the room?—I should not think there would be more than ten or twenty.

How were the finished lamps arranged?—They were hung on frames with two little loops of bare wires.

How did the wires run?—They were wooden framed with a wire on each side of the frame, back and front, and the wire went across the frame, and that connected these parallel wires to this third wire, as we found it convenient for the purpose of equalising the pressure on the two sides of the system.

Were the lamps used for lighting arranged so that you could turn them on or off, individually, according to the amount of light required, or the part of the room where the light was wanted?—Yes.

How did the third wire act?—It conveyed the difference of the current on the two sides back to the machine.

Was the difference on the two sides sometimes considerable?—Sometimes it was very considerable; it varied very much.

How long was that system up, and during what time?—At least three months?—I should think it was in use from March 15th onwards.

During that time were members of the public admitted to the room?—Very freely.

When was the National Electrical Company wound up?—I think it was a very long time afterwards.

Did you make the diagram before my lord?—Yes.

Does it correctly represent what the process was?—Yes, it substantially represents it.

Mr. ASTON: I follow this with great care, and I am justified in saying that the evidence does take us by surprise. My application is that we should adjourn to consider what our position is.

Mr. JUSTICE ROMER: And then you will make up your mind whether you go on, or whether you do not.

Mr. ASTON: Certainly; and we are now in the position to ask your Lordship to take all matters into consideration, having regard to the period at which this amendment is made.

Mr. JUSTICE ROMER: How long shall you want?

Mr. ASTON: We must go down to Glasgow.

Mr. JUSTICE ROMER: Of course. How long do you say.

Sir HORACE DAVEY: I ought to tell my learned friend I have proofs of two other witnesses; one an electrical engineer engaged in the works with this gentleman, and the other a director of the company.

Mr. ASTON: Wouldn't it be best to examine them now?

Mr. JUSTICE ROMER: No; I think not. You know now what you have to meet.

Mr. ASTON: I ask for an adjournment for a week, with liberty to apply meanwhile, if necessary.

Mr. JUSTICE ROMER: Perhaps you will be able to let the Court know whether it will be going on actually on Monday or not, in order that the time of the Court may be saved as far as possible.

It was accordingly arranged that the case should be in the paper for further hearing on Monday, the 14th inst., subject to any application either party may make after communication with the other.

It having been found impossible for the plaintiff's in this action to complete their inquiries in connection with the alleged anticipation by the National Electrical Company, at Glasgow, by Monday last—the day on which the case was to have again been down for hearing—the parties have agreed that the action shall stand out of Mr. Justice Romer's list for trial, with liberty for either the plaintiff or the defendants to apply to restore it. The learned judge's sanction to this course has been obtained.

NEW PATENTS—1892.

19,496. "Improvements in and relating to electro-magnets and magnetic circuits." W. LOWRIE. Dated October 31st.

19,497. "Improvements in electric lamps and in their manufacture." H. CLEGG. Dated October 31st.

19,543. "Improvements in electric indicating apparatus." L. B. STEVENS. Dated October 31st.

19,547. "Improvements in microphones." R. DAMSEAUX. Dated October 31st.

19,569. "Improvements in electrical connections." O. FERGUSSON. Dated October 31st.

19,602. "Improvements in electric switches." A. B. BLACKBURN. Dated November 1st. (*Complete.*)

19,637. "Improvements in apparatus or presses for forming pipes of, or covering cables or other articles with, a material in a ductile or plastic condition." J. C. ETCHELLS. Dated November 1st.

19,646. "Improvements in the method of supplying electrical energy of required potential to electric current circuits." W. LOWRIE. Dated November 1st.

19,655. "Improvements in and relating to a method of and means for heating by electricity." H. G. O'NEILL. Dated November 1st. (*Complete.*)

19,657. "Improvements in underground conduits for electric cables." R. EWING. Dated November 1st.

19,665. "Improvements in and relating to telephonic apparatus." G. S. HOOKER. Dated November 1st.

19,671. "Improvements in means for conducting electricity for electric lighting and other purposes." M. W. POLLARD. Dated November 1st.

19,690. "Improvements in and connected with the distribution of current in incandescence electric light circuits." O. A. ENHOLM. Dated November 2nd. (*Complete.*) (Date applied for under Patents Act, 1883, Sec. 103, October 3rd, 1892, being date of application in United States.)

19,699. "Improvements in telephonic apparatus." D. SINCLAIR. Dated November 2nd.

19,714. "Improvements in dynamo-electric machines." H. CHITTY. Dated November 2nd.

19,729. "Improvements in and means or apparatus for rectifying alternating currents for working continuous current motors, and for electrolytical purposes." C. POLLAK. Dated November 2nd.

19,730. "Improvements in distributing boxes for electric light, and power mains for underground and aerial purposes." G. J. PHILPOTT and A. J. WILLETT. Dated November 2nd.

19,738. "Improvements in portable electric safety lamps and batteries and appliances for charging them." THE EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY, LIMITED, and E. A. GIMINGHAM. Dated November 2nd.

19,739. "An improved electrical switch." E. L. JOSEPH. Dated November 2nd.

19,749. "Improvements in the construction of indicating and transmitting instruments for telephones." H. HARRIS. Dated November 2nd.

19,758. "Improvements in electric conductors." W. LOWRIE. Dated November 2nd.

19,761. "Improved means for obtaining electricity on board ship." H. R. MALTBY. Dated November 2nd.

19,771. "Improvements in and relating to telephonic instruments." J. MUIRHEAD. Dated November 3rd.

19,821. "Improvements in alternate current transformers for variable loads." SIEMENS BROS. & CO., LIMITED. (Communicated by Messrs. Siemens & Halske, Germany.) Dated November 3rd.

19,834. "Improvements in and relating to telephonic switching apparatus." A. R. BENNETT. Dated November 3rd.

19,874. "Improvements in means or apparatus for regulating the supply of electrical energy to lamps and other apparatus." E. P. DAVIS and A. C. COLLINS. Dated November 4th.

19,880. "The manufacture or production of an improved anode for use in electrolytical processes." T. PARKER and A. E. ROBINSON. Dated November 4th.

19,881. "Apparatus for controlling electric pressure in alternating current circuits." P. W. D'ALTON and J. A. FLEMING. Dated November 4th.

19,886. "Improvements in making house connections with electric lighting mains" W. FULLER. Dated November 4th.

19,889. "An improved electric clock." A. E. VIDAL and G. HERVIEU. Dated November 4th.

19,910. "Improvements in reflectors for electric and other lamps and lights." P. G. EBBUTT and J. B. VERITY. Dated November 5th.

19,916. "Improvements in electrical conductors and in means of making connection therewith." C. T. J. VAUTIN. Dated November 5th.

19,919. "Electric light conductors." G. F. DE SOLOME. Dated November 5th.

19,927. "Improved means for lighting railway cars by electricity." J. KORNER. Dated November 5th. (*Complete.*)

19,953. "Improvements relating to the construction of electrodes for electrolytic purposes." J. C. RICHARDSON. Dated November 5th.

19,959. "Improvements in the means or apparatus for measuring electricity." E. H. P. HUMPHREYS and W. FRIESE-GREENE. Dated November 5th.

19,960. "Improvements in ammeters and voltmeters." E. H. P. HUMPHREYS and W. FRIESE-GREENE. Dated November 5th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

13,942. "Improvements in or connected with apparatus for completing and interrupting electric circuits." T. PARKER, J. H. WOODWARD and E. S. G. REES. Dated August 18th. The inventors provide an electro-magnet which can be energised from any desired distance by completing the circuit in which the coils of the electro-magnet are situated, the said magnet when so energised operating a device by which a switch is moved so as to complete the supply circuit main. In proximity to the said device is another electro-magnet with its coils in the supply circuit main, and with an armature so adjusted that when the current in the said main is not above normal, the said armature remains stationary, but should the current in the said main become excessive the armature is attracted, and in its movement acts upon the aforesaid device so as to break the supply circuit main. 3 claims.

19,370. "A new or improved device for supporting shades or reflectors for incandescent electric lamps." E. DUNAND. Dated November 9th. Two loops of wire are employed, the upper ends of such wire loops

being brought together two by two, and attached by soldering, looping, or looping and soldering to a gallery or ring. This gallery or ring may be made with a short neck-like prolongation or rim, and when so made, may receive directly the shade, whether of porcelain, china, glass, or of textile material or of paper. 2 claims.

20,699. "A new or improved electric indicator." H. W. THATCHER and A. DEVEREUX. Dated November 27th. Relates to an improved electric apparatus for furnishing indications by means of a pointer moved upon a dial either for indicating stations in railway carriages for telegraphic, or for any other purpose, in which the step-by-step action of a pointer can be utilised. The inventors provide an escapement wheel mounted upon an axis held in any suitable manner, and carrying on its outer end a hand or pointer moving upon a dial furnished with names of stations, or with any other suitable indications, divisions, and the like. In close proximity to the said escapement wheel is arranged a spring and an electro-magnet, the armature of which is mounted on the said spring, and carries an anchor or pallets engaging with the said wheel in the same manner as in clockwork. They further provide an electric battery, to the two poles of which are attached two wires leading to the electro-magnet and to a suitable contact-making device, by means of which the apparatus is operated, a tooth of the escapement wheel being moved each time contact is established. 2 claims.

21,476. "Improvements in electric meters." A. G. WATERHOUSE. Dated December 8th. Consists of an apparatus consisting first, of an electrolytic cell, containing a liquid which permits a current to pass through it only by means of the decomposition of such liquid or electrolyte, and with conductors and electrodes leading to the electrolyte; second, a peculiar gas receiver which is capable of collecting and retaining the gas or gases liberated by the current, and of expelling such gas or gases when a certain quantity of the same has been collected; third, of accessory means of recording the amount of gas collected, and of electrical conductor and connections through which the current to be measured is passed. 6 claims.

21,541. "An improved method of mechanically strengthening dynamo-electric machine inductors." L. PYKE and E. S. HARRIS. Dated December 9th. Consists in interleaving thin sheets of hard metal between the laminæ of soft iron which constitutes the inductor. 1 claim.

21,728. "Improvements in electric arc lamps." A. G. WATERHOUSE. Dated December 11th. Comprises improvements, first, in a weather-proof lamp frame; second, in the method of construction of the lamp so that its parts can be joined together and insulated by means of cement; third, in its general form with a view of simplifying its construction; fourth, in the method of constructing and joining its electro-magnets and controlling mechanism; fifth, in its automatic shunt circuit breaker; sixth, in the means of producing a slow and even feed to the upper carbon; seventh, in several accessory and equivalent devices. 19 claims.

21,961. "Improvements in variable resistance devices for relays, telephones, and the like." H. H. LAKE. (Communicated from abroad by C. Cuttriss, of America.) Dated December 15th. The invention involves a device which may be regarded as the rheostat, and which consists of a resilient body in the form of a wire or strip, preferably of a resistant material such as carbon, and which is bent or wound upon itself, so that different parts or convolutions may lie in the same lines or planes such as in the case of a solenoid, volute or spiral. In practice a true spiral form is preferred, so that as the wire or strip is distended or compressed, different parts of its convolutions or spires will be drawn out of or forced into contact to a greater or less extent, depending upon the degree of distension or compression. Such a device included in an electric circuit between a fixed point of resistance and a body movable in response to electric or other waves or impulses is utilised to vary the resistance of such circuit for the control of a relay instrument or for other purposes.

21,963. "Improvements in electric railway systems." M. W. DEWEY. Dated December 15th. Consists chiefly in the combination in an electric railway of a source of irregular or alternating currents, conductors extending therefrom, a series of coils placed at intervals along said railway and connected in parallel with said conductors, normally closed magnetic circuits for the coils, a vehicle, a conductor upon the vehicle to be placed in inductional relation to the magnetic circuits successively, and an electric motor to move the vehicle in circuit with the latter conductor. 12 claims.

22,473. "Improvements in electrical heating apparatus." C. DREVS. Dated December 23rd. An electrical current is sent through a number of resistances in a vessel or cell of insulating material, and the ambient air is allowed constantly to pass through such vessel or cell, the heat generated in the resistances will then be imparted to the air. 3 claims.

22,785. "Improvements in the field magnets of dynamo-electric machines." L. PYKE and E. S. HARRIS. Dated December 30th. The inventors surround the coil with a cast, forged or otherwise shaped mass of magnetic material on its inner and outer circumference and on one face, said magnetic mass extending on its open face beyond the edge of the coil. They then close the said face, except at a narrow zone sufficient for the rotation of the armature or inductors, by placing on and in the said extensions of the magnetic mass nicely fitting flat annular laminæ, arranged so as to form a continuation of the field magnet and provided with such polar extensions or projections, as may be desired. 1 claim.

22,482. "Improvements in voltaic cells." H. H. LAKE. (Communicated from abroad by E. Weston, of America.) Dated December 23rd. Consists of a voltaic cell, the temperature coefficient of which is practically invariable. The inventor uses as an electrolyte a saturated solution of cadmium salt in water, and as electrodes an amalgam of cadmium and mercury opposed to an electrode of pure mercury and proto-sulphate of mercury. 2 claims.

CORRESPONDENCE.

Water-Motors.

I have expressed before my sense of the indebtedness of your readers to Mr. Tremlett Carter for his recent papers on this matter.

Now if he will add to them, by way of appendix, a full account of the results he gives us in one case where, with a fall of 74 feet and 900 cubic feet of water per minute, 78·17 per cent. of brake H.P. was got, and also say that he was present, and is prepared to go into a witness box and prove it—he will have gone a long way on the road (not the whole distance) towards satisfying me that there is some foundation for the claims of high efficiencies got from turbines; I say not the whole distance, because that I will only grant when I have seen it done myself.

In explanation of my incredulity and somewhat bigoted refusal to accept other people's results, a few words of explanation are due.

I have, in the course of my long experience, found great need for it; year after year I have known men, with the most honourable intentions, deceive themselves with all sorts of experiments, inattention to small matters, ignorance of the rigorous strictness required in such work, and perhaps well intentioned hope to get good results, have led them to give a too favourable reading to the indications they were observing.

Amongst many other questions let me cite the case of mechanical ventilators for mines.

When I began work there was nothing but the heated upcast or furnace ventilation; but in 1857, for the first time, a mechanical ventilator was described to the Northern Mining Institute, although in 1657 Agricola, in his interesting work "De re Metallica," gave drawings and particulars of one worked by hand. From 1857 to the present time we have had yearly one or more of these machines submitted to us for approval, all alleged to have given 70 per cent. and upwards; and invariably, when strictly tested, such results have failed to be attained.

I have taken great interest in the question, have acted on committees, read papers myself on the subject, and twice translated and published works by French engineers, and I have always found these big results arose from want of care in making observations. Now if this has occurred in the case of air, how do I know that the same errors are not existing when water machines are in question?

The first source of error is in the air measurement. I once went to Nottingham where gentlemen of high ability and standing said wonderful things had been done. Two of them were government inspectors. I found the anemometer had been held in one position where average results might be expected, but on getting a ladder and reaching the top of the drift, I found a current actually going backwards—it rushed up to the fan and reversed—ending in a lessened efficiency of nearly 20 per cent.

Then there is more than one kind of error arising from the observation of the vacuum or water gauge: 1. Want of skill or care in reading it. 2. A ventilator, if too small, gives a false vacuum.

The depression or water gauge is in keeping with the speed of the periphery, and varies, first, according as the machine is good or bad; second, with its position in relation to the fan, many people put it close to the inlet, but if they go 20 feet back, they get a very different result; the fan has caused the vacuum, but, being too small, cannot swallow the volume; what we call its "orifice of passage" is too small. Then again, inaccurate timing is a frequent cause of error. We have fans 45 feet in diameter, and a single turn, or even half a revolution wrong, makes all the difference. Now, having seen all these popular fallacies exploded, I naturally say let us take nothing for granted. Facts we must have. American flumes don't admit of strict measurements.

I have occupied so much of your space that I must not allow myself to discuss what they will do at Niagara when the turbines fail to give the anticipated results. I only said that having quite as much experience as the engineers there, I refused to take their estimate of what a turbine will give. Electrical engineers are far more interested in this question

than I am, and I say let us have the whole facts, and nothing but the facts.

A. L. Steavenson.

November 12th, 1892.

The Meter for the Million.

It certainly is startling to find that the complex, delicately constructed, and faulty meters hitherto brought out for measuring electricity supply, are seriously offered to the public.

If grocers and tobacconists were offered 40 guinea chemical balances to weigh out butter, sugar, tobacco, &c., said balances to be fixed by an expert and carefully preserved in a glass case, that also would be startling.

The grocers' balance and weights are not absolutely correct, no one expects them to be so; often they are far wrong and have to be corrected, all the same they are perfectly fit for the purpose, much more so than a correct, refined, delicate chemical balance would be.

Gas meters, like grocers' balances, are for everyday use in a rough and ready way, and to find a percentage of the millions of them in everyday use going wrong is only what is to be expected; everything made by human hands is liable to go wrong. To talk of correcting a gas meter for changes of temperature is equivalent to proposing to correct a blacksmith's three-foot rule for changes of temperature; no such refinement is necessary. The gas meter, as a class, behaves well in the circumstances under which it has to do its work; its principle is correct, and its performance during many years has proved its perfect fitness for the work. That a few individuals in the class are inclined to misbehave is no reason why we should condemn the whole class as unfit.

The electricity meters before the public at the present moment are all of them open to the serious objections stated in the article; it is not to the failure of a few meters in any class the objections apply, but to the whole class.

Mr. Fairfax is not acquainted with Patent Office records, else he would know that the meter for electricity is not such a recent subject as his letter implies, for 15 years, at least, it has been in the hands of eager inventors and yet we have only the chemical meter, the motor meter, and the clock or watch-work meter; we still want "the meter for the million."

The Writer of the Article.

November 12th, 1892.

Train Lighting.

I notice in your leading article this week, *re* the Thirsk accident, that in speaking of the different railway companies who have attempted to thrash out the important question of train lighting by electricity, great prominence is given to the comparatively recent experiments on the Midland Railway, and that the Great Northern is mentioned as having made "some effort to establish electric lighting in some of their trains, *which was not successful*." The latter assertion I beg to state is absolutely untrue, as eight complete trains lighted throughout by electricity from a dynamo driven from the axle of the break van, have been for the last seven or eight years, and *are now* running continuously and giving every satisfaction—notwithstanding the fact that gas is used in some other trains.

An attempt was, however, made some two or three years since to light three dining cars by accumulators charged and placed under the seat of the carriages at the commencement of the journey. This, however, was abandoned, chiefly on account of the expense and inconvenience always attendant on such a system.

The fact of these cars being attached to one of the most important express trains, has probably given rise to the erroneous impression that this was the only experiment in train lighting by electricity attempted by the Great Northern Railway, whereas, as a matter of fact it was the smallest and least important. I myself having been engaged for the last eight or nine years in conducting extensive experiments in this direction, am in a position to speak with confidence of the successful running of the above mentioned trains, both on the suburban and main lines. Seeing that this is not the first time that the Great Northern system of train lighting by electricity has been relegated to a back seat (doubtless unintentionally), and, as you do not wish to be deemed guilty of an injustice, I trust you will kindly insert this letter in your next issue.

F. W. Cooke, A.I.E.E.,
Electrician Great Northern Railway, Retford.

Dry Cells.

We notice in your issue of November 11th an enquiry from a correspondent who signs himself "Voltaic," with reference to dry cells, in reply to which we shall be glad if you will insert in your valuable columns the following particulars regarding the E.C.C. dry cell. This battery has been taken up by many of the leading railway and telephone companies, and also by the G.P.O., besides which it is selling in thousands to electrical engineers and others all over the country and in the colonies. Your correspondent asks "are they as cheap and durable as the ordinary cells, and can they be used for the same work as the common cells, and do they give the same satisfaction?" The following prices and particulars show their cost, also size and statistics. We think these cannot fail to answer your correspondent's queries.

PRICES AND PARTICULARS.

	Diameter.	Height over all.	E.M.F.	Int. Res.	Price.
No. 0	4½ × 2¼ in.	6 inches.	1·5 volts.	0·30 ohms.	5/-
„ 1	3¼ inches.	8 „	1·5 „	0·35 „	4/-
„ 2	2½ „	7 „	1·5 „	0·70 „	3/3
„ 3	2 „	5¾ „	1·5 „	0·85 „	2/6
„ 4	1½ × 1½ in.	4½ „	1·5 „	.....	2/-

We take back exhausted cells and renew at half original cost.

With regard to the satisfaction they give, we can only add that if repeat orders and unsolicited testimonials are criteria of efficiency, then we can have no hesitation in saying that this battery is not only as satisfactory as the ordinary Leclanché, but even more so.

The General Electric Company, Limited.
MAX BIRSWANGER, *Director.*

November 12th, 1892.

I have great pleasure as one of your readers to reply to "Voltaic," in "*re* Dry Batteries." There is not one which will last any time; in a month they are utterly useless, except the small piece of carbon with the leaden caps and screw. First, there is a zinc box, 2½ inches diameter and 7 inches long, the interior of which ought to be *amalgamated*, then covered with ⅛th of an inch coating of stucco or plaster of Paris. The interior is then packed with a mixture of peroxide of manganese, and chloride of ammonium in the ratio of one to five. In the centre of the packed mass is a carbon plate, like that of a Leclanché cell, with binding screw; the top of the box is now sealed with pitch. When this cell is exhausted it cannot be renovated. It is an error to call them dry batteries; there must be some dampness in all of them in order that chemical action may take place. I should advise "Voltaic" to try the Leclanché-Barbier dry cell, which is *not* a *dry cell*, and when it ceases to act it can easily be renovated by taking out the plug and pouring in a saturated solution of sal. ammoniac (Cl_1 N H^4).

R. T. Dick.

[We have had to delete several lines from Mr. Dick's letter, as they are distinctly libellous. It is almost unnecessary to add that his statement as to the uselessness of the batteries after a month's work is quite incorrect.—EDS. ELEC. REV.]

"Voltaic" will find the Leclanché-Barbier patent cylindrical agglomerate dry cells quite as cheap, durable, and satisfactory, as ordinary wet cells, for which they are a convenient substitute. The cell is composed of an outer zinc cylinder and an inner agglomerate cylinder, the two being cemented together by a composition containing an ammoniacal salt. The E.M.F. is 1·5 volts, and the internal resistance varies from 0·5 to 0·6 ohms, according to size.

C. A. Gawthorp.

November 14th, 1892.